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Original Research

Risk Factors Associated With Suicidal Ideation in Individuals With Spinal Cord Injury

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KEYWORDS
Depression;
Rehabilitation;
Spinal cord injuries;
Suicidal ideation

Abstract *Objective:* To assess the frequency of suicidal ideation (SI) among individuals with chronic spinal cord injury (SCI) and to identify risk factors associated with SI.
Design: Cross-sectional.
Setting: Community setting.
Participants: Two hundred and forty-six individuals with chronic SCI participating in the Spinal Cord Injury Model Systems at a Level 1 Trauma center.
Interventions: Not applicable.
Main Outcome Measure: SI, as assessed by question 9 of the Patient Health Questionnaire-9.
Results: Twenty-seven (11.0%) participants endorsed SI; 6 (22.2%) of whom endorsed active SI with a plan of self-harm. Participants who endorsed SI had significantly higher depressive symptoms, lower resilience, and lower satisfaction with life (all *P*s<.001). They also had lower perceived health (*P*<.001), Craig Handicap Assessment & Reporting Technique Short Form (CHART-SF) physical independence (*P*=.013), and Spinal Cord Injury — Functional Index with Assistive Technology domains of basic mobility (*P*=.003), self-care (*P*=.042), and fine motor skills (*P*=.035). However, participants who endorsed SI were not significantly different in re-hospitalization rates and in other domains of CHART-SF and SCI-AT. Logistic regression, with a forward selection

List of abbreviations: CHART-SF, Craig Handicap Assessment & Reporting Technique Short Form; IQR, interquartile range; OR, odds ratio; PHQ, Patient Health Questionnaire; SA, suicide attempt; SCI, spinal cord injury; SCI-FI AT, Spinal Cord Injury — Functional Index with Assistive Technology; SCIMS, Spinal Cord Injury Model System; SI, suicidal ideation; SWLS, Satisfaction with Life Scale.

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procedure, was used to identify significant predictors of endorsing SI in the context of multiple associated variables. Depressive symptoms (odds ratio [OR]=1.18, *P*=.020), resilience (OR=0.85, *P*=.003), and physical independence (OR=0.98, *P*=.019) remained significant predictors of SI.
Conclusion: Study findings suggest higher levels of SI among people with SCI, a substantial proportion of whom have active SI. Individuals with SCI who endorse SI have greater burden of poor physical and mental health, as well as poorer functional status and adaptation. Interventions targeting multiple dimensions of quality of life may help reduce risk of SI and suicide among individuals with SCI.

Approximately 17,810 individuals in the United States experience a traumatic spinal cord injury (SCI) each year and an estimated 294,000 persons are currently living with a SCI.[1] Individuals with SCI often experience significant comorbidities and functional impairment, including paralysis, respiratory compromise, neurogenic bowel, neurogenic bladder, chronic pain, and difficulty conducting daily tasks (eg, bathing and grooming).[2-9] In addition to experiencing significant physiological concerns and impairments to everyday functioning, individuals with SCI are also at increased risk of experiencing psychological distress, including increased depression, anxiety, post-traumatic stress disorder, and social isolation, which may contribute to higher rates of suicidal ideation (SI) in individuals with SCI compared with the general population.[10-16] Indeed, research suggests that the experience of SI is significantly more common among persons with SCI, with an estimated 13.3% prevalence of SI within 2 weeks of screening, than among individuals of the general US population, who have an estimated annual prevalence of 3.7%.[10,17,18]

Corollary to the higher rates of SI are elevated prevalence rates of suicide attempts (SAs) among individuals with SCI, who have an estimated 7.4% lifetime prevalence rate that exceeds the 4.6% lifetime prevalence of SA reported for the general US population.[10,19,20] Furthermore, there is a 3-fold higher rate of mortality due to suicide among individuals with SCI compared with the general population.[21] Process models of suicide (eg, "ideation-to-action" frameworks) posit a continuum of risk for attempting suicide that begins with SI, is progressed by a proportion of individuals with SI making a plan, and is culminated by a fraction of those with a plan attempting suicide.[22,23] Multiple research studies support such developmental models of suicide risk and generally consider SI to be a significant predisposing risk factor for both fatal and nonfatal SA.[23-25] Consequently, there is an imperative for identification of risk factors for SI to limit progression toward suicide among individuals with SCI.

Relative to the large body of work examining risk for SI in the general population, limited research has examined predictors of SI among individuals with SCI.[10,11] Previous work has identified some injury-related and psychosocial factors to be related to SI among individuals with SCI.[10] Specifically, SI has been found to be associated with increased time since injury, a history of depression, previous SA, low levels of engagement in rewarding activities, low levels of emotional resilience, poor sense of control in community participation, and lower spiritual well-being.[10,11,26] Although previous work has laid a foundation for potential interventional targets, the identified risk factors likely constitute only a subset of a much larger corpus of factors that contribute to risk of SI; thus, more work still needs to be done to fully understand risk for SI among individuals with SCI.[10,11,26] As a result, this study was motivated to further examine risk factors for SI. Specifically, this study aimed to assess the frequency of SI among community-dwelling individuals with chronic SCI and to identify demographic, medical, and psychosocial risk factors associated with their experience of SI.

Methods

Participants and procedures

Participants were 246 individuals with SCI enrolled in the Spinal Cord Injury Model Systems (SCIMS) at a Level 1 trauma center. Eligibility criteria for the SCIMS generally include: (1) diagnosis of a traumatic SCI, (2) temporary or permanent loss of sensory and/motor functions, (3) receipt of initial inpatient rehabilitation at a SCIMS hospital system within 1 year of injury, (4) residence in the geographic catchment area of a SCIMS, and (5) US citizenship or permanent residency. This study received approval from the local Institutional Review Board and all participants provided documentation of informed consent.

Participants included in this study completed a Form II follow-up survey.[27] Form II surveys are structured interviews that are typically completed by phone or as a self-administered mailed questionnaire. Individuals selected for analysis in this study completed Form II follow-up surveys between April 2017 and December 2019 following institution of a site-specific suicide risk assessment protocol that triaged individuals endorsing SI on item 9 of the Patient Health Questionnaire (PHQ)-9 to a clinician for risk assessment and management. The data in this study are cross-sectional with only 1 follow-up period per participant.

Measures

In addition to sociodemographic data (ie, age, sex, race, education, employment status, marital status, type of insurance, and income) and medical variables (ie, level and completeness of injury, and rehospitalization within the past year), the following were obtained by participant self-report on Form II surveys.

Patient Health Questionnaire − 9

The PHQ-9 is a widely used and validated 9-item diagnostic measure based on the Diagnostic and Statistical Manual IV that screens for emotional distress and depression.[28] Scores range from 0 to 27 with higher total scores showing severity of depression. Reliability in this sample was good (α=.833).

The presence of SI was determined using item 9 of the PHQ-9; scores of 1 ("several days") or greater were considered indicative of SI in the last 2 weeks. To assess depression independent of SI, item scores on the first 8 questions were summed (ie, PHQ-8). Reliability of the PHQ-8 in this sample was good (α=.833).

Resilience

Resilience was measured using the Spinal Cord Injury-Quality of Life short form, a validated 8-item survey that evaluates perseverance, adaptability, and positive behavior to stress and life changing experiences.[29,30] Scores range from 8 to 40 with higher total scores indicating more resilience and adaptability. Reliability in this sample was excellent (α=.903).

Satisfaction with Life Scale

The Satisfaction with Life Scale is a validated 5-item instrument that measures an individual's overall life satisfaction while accounting for one's achievements and expectations.[31] Participants respond using a 7-point Likert scale (1=Strongly Disagree, 7=Strongly Agree) with scores ranging from 5 to 35. Higher scores indicate extreme satisfaction in one's life while a score of 20 indicates neutral satisfaction. Reliability in this sample was good (α=.865).

Craig Handicap Assessment & Reporting Technique Short Form

Craig Handicap Assessment & Reporting Technique Short Form (CHART-SF) is an index of handicap and consists of 4 domains: Physical independence, Mobility, Occupational, and Social Integration.[32-34] The CHART-SF measures how well individuals with disabilities function as members of their community. Each domain of the CHART-SF is scored from 0 to 100. Higher scores are expected among individuals with greater social and community participation and among those living with little to no degree of handicap. Reliability in this sample was acceptable (α=.667).

Spinal Cord Injury − Functional Index with Assistive Technology

Spinal Cord Injury − Functional Index with Assistive Technology (SCI-FI AT) was used to measure ability to perform functional activities without the assistance of a helper in 3 domains: Basic Mobility (9 Items), Self-Care (9 Items), and Fine Motor (8 Items). The self-care and fine motor domains assessed physical independence with respect to general level of injury (ie, paraplegia or tetraplegia) while the item bank for basic mobility was the same for all respondents. For each domain, a T score between 0 and 100 was calculated from their raw scores and higher T scores indicated greater functional ability. Reliability in the sample for was excellent (α=.930).

Perceived Health

Perceived health status was measured using a single item from the Medical Outcomes Study SF-36.[35] Participants were asked to generally rate their perceptions of their physical health over the past year on 5-point Likert scale, ranging from "1" (excellent) to "5" (poor). This and similar single-item measures of global health have been widely-used in the literature and shown to relate to morbidity and mortality.[36-38] Responses to this item were reversed for the interpretation of better health with increasing scores.

Perceived Pain

Severity of pain was assessed using a single item pain measure adapted from the Brief Pain Inventory.[39] Participants were asked to rate their usual level of pain over the past 4 weeks on a numeric rating scale, with anchors ranging from "0" (no pain) to "10" (pain so severe you couldn't stand it).

Statistical analysis

To examine risk factors associated with endorsing SI, difference tests were used to compare characteristics among individuals endorsing and not endorsing SI. Differences between groups on continuous normally-distributed variables were examined using *t* tests while differences between non-normally distributed variables were compared using Mann-Whitney *U*-tests. Differences between groups on categorical risk factors were examined using χ^2-tests. These bivariate analyses were used to identify a set of variables significantly associated with endorsing SI from a pool of potential covariates that differed to some degree among individuals endorsing vs not endorsing SI ($P<.10$).

Following this, multivariable logistic regression was used to model endorsement of SI in the context of multiple risk factors. In particular, a forward selection procedure was used among the set of identified variables with some association with endorsing SI. In this stepwise selection procedure, the first variable was entered into the model based on statistical significance. For subsequent variables, entry into the model was based on the size of partial correlations and removal was based on the probability of a likelihood-ratio statistic. Statistical significance in the multivariable logistic regression was defined as an alpha level of 0.05. Cases were excluded if there were missing on an independent variable in the model. Rates of missing data ranged from a low of 0.8% to a high of 7.3% on assessed study variables (mean=4.4%). All analyses were conducted in SPSS v.24.[a]

Results

Across all participants (N=246), the average age at follow-up was 55.4 (SD=10.2) years and the median (interquartile range [IQR]) duration of injury was 25[20,a] years. Most participants were men (78.1%), White (76.8%), non-Hispanic (86.6%), with a college/tertiary degree (56.9%), and with Medicare/Medicaid as their primary insurance (62.2%). Most participants had tetraplegia (50.4%) and complete injuries (59.8%). A substantial minority of participants were married (43.1%) and employed (30.1%). Other participant characteristics are presented in table 1.

Twenty-seven (11.0%) of participants endorsed SI. Table 1 also presents comparisons of participant demographic,

Table 1 Demographics and substance use characteristics among study participants by non-endorsement vs endorsement of suicidal ideation

Sample Characteristic	Full Sample (N=246)	SI Endorsed (N=27)	SI Not Endorsed (N=216)	Test Statistic
Age, Mean ± SD				
At injury	26.88 (9.70)	28.26 (10.29)	26.78 (9.67)	$t(241)$=-0.743, P=.458
At last follow-up	55.40 (10.22)	56.96 (10.85)	55.19 (10.13)	$t(241)$=-0.853, P=.395
Men, N (%)	192 (78.05)	20 (74.07)	169 (78.24)	X^2 (1)=0.241, P=.627
Race, N (%)				
White	189 (76.83)	22 (81.48)	164 (75.93)	P>.999
Asian	15 (6.10)	2 (7.41)	13 (6.02)	P=.688
African American	6 (2.44)	0 (0.00)	6 (2.77)	P>.999
Multiracial	15 (6.10)	1 (3.70)	14 (6.48)	P>.999
American Indian	2 (0.81)	1 (3.70)	1 (0.46)	P=.219
Hispanic ethnicity, N (%)	33 (13.41)	2 (7.40)	31 (14.35)	P=.549
Tetraplegia, N (%)	124 (50.40)	12 (44.44)	109 (50.46)	$X^2(1)$=0.375, P=.540
Complete, N (%)	147 (59.80)	19 (70.37)	127 (58.80)	$X^2(1)$=1.341, P=.247
Duration from injury, Median [IQR]	25 [20, 40]	25 [20, 40]	25 [20, 40]	U=2831.500, P=.802
Married, N (%)	106 (43.10)	14 (51.85)	91 (42.13)	$X^2(1)$=1.651, P=.199
Higher education, N (%)				
At enrollment	47 (19.11)	7 (25.93)	40 (18.52)	$X^2(1)$=0.587, P=.449
At last Form II	140 (56.91)	15 (55.56)	124 (57.41)	$X^2(1)$=.001, P=.980
Employed, N (%)	74 (30.08)	9 (33.33)	65 (30.09)	$X^2(1)$=.182, P=.670
Income, Median [IQR]	2 [1, 4]	2 [1, 4]	2 [1, 4]	U=1827.000, P=.293
Medicare or Medicaid, N (%)	153 (62.20)	17 (62.96)	133 (61.57)	$X^2(1)$=0.086, P=.769
Substance use				
Alcohol use, N (%)	169 (68.70)	19 (70.37)	148 (68.52)	$X^2(1)$=0.001, P=.981
Other substance use, N (%)	89 (36.18)	12 (44.44)	75 (34.72)	$X^2(1)$=1.238, P=.266

NOTES. 3 (1.2%) did not provide a response to the PHQ-9 probe for suicidal ideation.
Family income levels are defined as (1) Less than $24,999, (2) $25,000-$49,999, (3) $50,000-$74,999, (4) $75,000 or more.

medical, and substance use characteristics by response to the PHQ-9 SI question (SI not endorsed vs SI endorsed); there were no differences among those endorsing SI and those who denied experiencing SI in these characteristics. Upon clinician follow-up of individuals who had endorsed SI, 6 (22.2%) participants endorsed active SI (ie, SI with a plan for self-harm).

Table 2 presents comparisons of psychological well-being, health status, and functional status by SI endorsement group. Participants who endorsed SI did not differ from those who did not endorse SI in rates of rehospitalization in the last year, CHART domains of mobility, occupation, and social integration, as well as SCI-FI AT domains of ambulation, manual wheelchair, and power wheelchair. However, they did significantly differ in their levels of psychological well-being, perceived health, CHART physical independence, and SCI-FI AT domains of basic mobility, self-care, and fine motor skills. In particular, individuals who endorsed SI had more depressive symptoms (Median [IQR] - 8.50 [6.00, 16.50] vs 4.00 [1.00, 7.00]; U=1008.00, P<.001), lower satisfaction with life (Median [IQR] - 18.00 [11.00, 20.50] vs 25.00 [20.00, 30.00]; U=1229.50, P<.001), and less resilience (Median [IQR] - 44.30 [36.70, 48.10] vs 53.50 [47.45, 61.70]); U=678.00, P<.001). Individuals who endorsed SI also had lower perceived health (Median [IQR] - 2.00 [1.75, 3.00] vs 3.00 [2.00, 4.00]; U=1553.50, P<.001, lower levels of physical independence (Median [IQR] - 76.00 [46.00, 96.00] vs 96.00 [76.00, 100.00]; U=1484.00, P=.013), lower SCI-FI mobility function (Median [IQR] - 47.11 [37.63, 51.04] vs 52.97 [46.01, 58.16]; U=1647.50, P=.003), lower ability to perform daily self-care activities (Median [IQR] - 53.51 [44.21, 57.83] vs 57.22 [48.48, 62.91]; U=2044.00, P=.042), and lower fine motor ability (Median [IQR] - 47.90 [39.07, 52.86] vs 53.01 [43.89, 61.54], U=1902.00, P=.035). Perceived pain was also marginally higher among participants that endorsed SI (P=.085) (table 2 and supplemental fig S1; available online only at http://www.archives-pmr.org/).

Covariates differing among individuals who endorsed SI and those who did not endorse SI (ie, depressive symptomatology, satisfaction with life, resilience, physical independence, basic mobility, self-care, fine motor skills, as well as perceived health and pain) were examined as predictors of SI in a multivariable stepwise logistic regression (table 3). In the context of multiple predictors, depressive symptoms (odds ratio [OR]=1.18, P=.02), resilience (OR=0.85, P=.003), and physical independence (OR=0.98, P=.019) were identified as significant predictors of the probability of endorsing SI. Based on the regression model, each 1-unit increase in depressive symptoms increased the odds of endorsing SI by 16.9%. Furthermore, each unit increase in resilience and physical independence decreased the probability of endorsing SI by 13.8% and 2.1%, respectively.

Discussion

Individuals with SCI experience elevated risk for suicide, with both higher rates of SI and SA compared with the

Table 2 Differences in potential covariates of SI among individuals endorsing and not endorsing SI

	SI Endorsed (N=27)	SI Not Endorsed (N=216)	Test Statistics
Psychological wellbeing, Median [IQR]			
PHQ-8 Total	8.50 [6.00, 16.50]	4.00 [1.00, 7.00]	U=1008.00, P<.001
SWLS	18.00 [11.00, 20.50]	25.00 [20.00, 30.00]	U=1229.50, P<.001
Resilience	44.30 [36.70, 48.10]	53.50 [47.45, 61.70]	U=678.00, P<.001
Health status, Median [IQR]			
Perceived health	2.00 [1.75, 3.00]	3.00 [2.00, 4.00]	U=1553.50, P<.001
Perceived pain	5.00 [2.75, 8.00]	4.00 [2.00, 6.00]	U=2185.50, P=.085
Hospitalization in the last year (%)	8 (29.60)	62 (28.70)	$X^2(1)$=.19, P=.667
CHART, Median [IQR]			
Physical Independence	76.00 [46.00, 96.00]	96.00 [76.00, 100.00]	U=1484.00, P=.013
Mobility	74.00 [57.00, 95.50]	89.00 [59.50, 100.00]	U=2144.50, P=.185
Occupation	53.50 [4.75, 80.00]	54.00 [23.00, 100.00]	U=2406.50, P=.300
Social integration	84.00 [67.50, 100.00]	100.00 [84.00, 100.00]	U=2141.00, P=.122
SCI-FI, Median [IQR]			
Basic mobility	47.11 [37.63, 51.04]	52.97 [46.01, 58.16]	U=1647.50, P=.003
Self-care	53.51 [44.21, 57.83]	57.22 [48.48, 62.91]	U=2044.00, P=.042
Fine motor	47.90 [39.07, 52.86]	53.01 [43.89, 61.54]	U=1902.00, P=.035
Ambulation	60.08	59.88 [57.91, 63.49]	U=40.00, P=.868
Manual wheelchair	56.21 [48.66, 58.81]	58.01 [52.66, 61.58]	U=664.50, P=.201
Power wheelchair	48.42 [41.30, 51.74]	44.85 [39.33, 50.79]	U=422.00, P=.414

NOTES. 3 (1.2%) did not provide a response to the PHQ-9 probe for suicidal ideation.
Only 2 participants were ambulatory, thus there is no IQR to report.

general population[21]; however, little research has examined risk factors for suicide in this population. This study examined the prevalence of SI and factors associated with endorsing SI among community-dwelling individuals with chronic SCI and found that 11% of respondents endorsed SI within the last 2 weeks — a rate similar to the 13.3% SI prevalence observed in a previous study and one significantly higher than the annual SI prevalence of 3.7% in the general population.[10,20] Furthermore, 6 out of the 27 participants that endorsed SI (22%) had active SI. These findings of high rates of recent SI, with a substantial proportion being active SI, may warrant routine screening of individuals with chronic SCI and establishing protocols for follow-up and risk assessment during health visits and research surveys.

Our primary findings were that individuals who endorsed SI had lower physical independence, lower perceived health, lower satisfaction with life, and higher levels of depressive symptoms. They also had marginally higher levels of perceived pain and rates of rehospitalization. Multivariable models comparing all risk factors that differed between individuals who endorsed recent SI and those who did not identified depressive symptoms, resilience, and physical independence to have unique and independent effects on SI, with depressive symptoms emerging as the strongest predictor for endorsing SI (based on ORs as a proxy for the relative strength of a predictor). Resilience and physical independence had protective effects, with higher scores associated with decreased probability of endorsing SI. Taken together,

Table 3 Multivariable logistic regression for the prediction of suicidal ideation using a stepwise procedure

		Estimate	Standard Error	Odds Ratio	Wald	df	P Value
Step 1*	PHQ-8	0.24	0.05	1.27	21.64	1	.000
	Intercept	-4.38	0.62	0.01	49.94	1	.000
Step 2†	PHQ-8	0.15	0.07	1.17	5.54	1	.019
	Resilience	-0.15	0.05	0.86	8.32	1	.004
	Intercept	3.45	2.62	31.40	1.73	1	.189
Step 3‡	PHQ-8	0.16	0.07	1.18	5.37	1	.020
	Resilience	-0.17	0.06	0.85	8.70	1	.003
	Physical Independence	-0.03	0.01	0.98	5.54	1	.019
	Intercept	5.96	3.06	388.52	3.80	1	.051

NOTES. SCI-FI basic mobility, SCI-FI self-care, SCI-FI fine motor, perceived health, perceived pain, and total SWLS score were included in the regression model but were not selected in the forward regression procedure.
Abbreviations: SWLS, Satisfaction with Life Scale
* Variable entered on step 1: PHQ-8.
† Variable entered on step 2: Resilience.
‡ Variable entered on step 3: Physical Independence.

our findings suggest poorer physical and mental health among those endorsing SI compared with those who did not endorse SI. Our findings also suggest similar risk factors for SI in individuals with SCI as those in the general population, such as depressive symptoms and lower life satisfaction,[20] lower actual and perceived physical health,[40] and decreased physical and social support.[41,42]

Similar to findings in previous work by McCullumsmith et al, we found no association between age, sex, race, marital status, or education level with SI - demographic factors that have been associated with the suicidality in the general population.[18,43-45] Sex, in particular, typically has robust associations with SI and parasuicidal behaviors. Although men are more likely to have a fatal SA, because of a tendency toward using more lethal means, women tend to have higher rates of reporting SI in the general population.[20,46,47] The lack of sex effects in our findings may be a consequence of our sample, and the population of individuals with SCI in general, being predominantly men. Larger sample sizes with more women may help clarify whether sex differences observed in the general population are also present among individuals with SCI.

Increasing patient access to health care and community resources may potentially ameliorate suicide risk as increasing contact with health care providers, mental health services, and peer support may alleviate the effect of physical comorbidities and psychological distress. The rise of mobile health technology and telehealth services presents a special opportunity to broaden health care services and coordination of care for patients with SCI.[48] For example, mobile technology allow for participation in regular home-based exercise programs,[49] nutrition counseling,[50] psychosocial counseling,[51] health coaching on various topics such as prevention of pressure ulcers, pain, and bowel management,[52] and for interaction with peers which has been shown to improve life satisfaction, and mental health among individuals with SCI.[53-55] On balance, harnessing mobile and telehealth technology may improve access to care for persons with SCI and improve monitoring of risk factors SI by health care providers.

Study limitations

Limitations of this study include its cross-sectional nature, relatively small sample size, and predominantly White sample. Larger and more heterogenous samples in future studies will allow for greater generalizability and replication of findings. Larger samples will also facilitate the use of more advanced multivariate statistical methods (eg, structural equation modeling) that are well-suited to examining complex associations between constructs like SI and candidate observed and/or latent factors that may be associated with SI. Secondly, as a result of the numerically small sample of individuals endorsing SI, our analyses did not distinguish between passive and active SI so we are unable to ascertain whether risk factors may differ between these levels of ideation. Finally, assessment of SI was at only 1 point in time. Research suggests both inter- and intra-individual variability in SI,[42] thus SI is not static and examinations of SI in cross-sectional studies excludes understanding of fluctuations of risk factors within individuals over time that would be better-investigated using longitudinal studies.

Conclusions

This cross-sectional study found that individuals with SCI endorsing SI had lower physical independence, lower perceived health, lower satisfaction with life, and higher levels of depressive symptoms. Furthermore, approximately, one-fifth of those endorsing SI had active thoughts of self-harm. Overall, findings point to poorer physical and mental health among those endorsing SI which may help providers and caregivers identify and support individuals with SCI at risk for SI and suicide. Further longitudinal work is required using larger heterogeneous samples of persons with SCI to understand SI in the context of SCI over time.

Suppliers

a. IBM SPSS Statistics for Windows v.24; IBM Corp.

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