Review

Psychosocial correlates of depression following spinal injury: A systematic review

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Objectives: Spinal cord injury (SCI) studies have identified a range of psychosocial risk and protective factors for depression post-injury. This study presents the first systematic and quantitative review of this body of research.

Methods: Twenty-four studies ($N = 3172$ participants) were identified through electronic database searches. Studies were evaluated according to recommended guidelines on Strengthening the Reporting of Observational Studies in Epidemiology (STROBE). The significance and magnitude of the relationships between standardised measures of depression and psychosocial outcome were examined using Pearson's effect size r , 95% confidence intervals and fail-safe N s. Effect sizes were categorised according to the ICF psychosocial domains.

Results: STROBE ratings indicated discrepancies in procedural detail and statistical analyses. Individual personal variables including affective feelings, and thoughts and beliefs specific to SCI demonstrated the strongest relationship with depression self-ratings. Life satisfaction, disability acceptance, environmental supports and community participation had a medium to strong association, helping to reduce vulnerability to depression. Longitudinal studies revealed that symptoms of depression continued to impact on psychosocial outcome up to 10 years post-injury, although this was based on limited data.

Conclusions: Assessment of psychosocial factors in the acute stages of SCI rehabilitation can inform evidence-based interventions to treat and manage depressive symptomatology in the short to longer-term. Future studies would benefit from adopting a unified approach to the measurement of depression post-SCI to help inform targeted treatment.

Keywords: Spinal cord injury, psychological adaptation, rehabilitation, depression

Introduction

Depression is the most common psychological issue following spinal cord injury (SCI), with moderate to extremely severe symptomatology reported by 25% of individuals with a traumatic injury,¹ and up to 26% of individuals meeting the criteria for Major Depressive Disorder.^{2,3} Left untreated, depressive symptoms may become chronic and negatively impact on health-related quality of life. This includes secondary health problems leading to recurrent hospitalisations,⁴ fewer functional gains,⁵ and reduced life expectancy.⁶

The high prevalence and clinical importance of depression has led to SCI research examining risk and protective factors. Historically, this research has targeted demographic and injury characteristics and physical function as predictors or modifiers of depressive

symptomatology.⁷⁻⁹ However, recent studies suggest that these variables do not have predictive value. Rather, psychosocial stressors have been noted to account for a significant amount of the variance in subjective wellbeing during the acute rehabilitation period and following discharge to the community.^{10,11}

Psychological variables that may lead to or magnify depression symptoms post-SCI include poor self-esteem and body image,¹² low self-efficacy in relation to one's injury,¹³ psychiatric comorbidities,^{14,15} and avoidant coping strategies such as behavioural disengagement and denial.^{13,16} Activity correlates of depressed mood have also been noted, although these findings are mixed. For example, there is evidence that feelings of helplessness and hopelessness can significantly impede a satisfying leisure lifestyle.¹⁷ However Bombardier *et al.*¹⁸ found that community participation levels did not independently predict depression ratings. Perhaps the most consistent finding is the association

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Figure 1 Flow chart of study selection.

between depression outcome and available social supports. Specifically, relationships which reinforce a person's sense of worth are associated with reduced depressive symptomatology post-SCI, whereas personal relationships that are strained can exacerbate emotional distress.^{19,20} However, an over-reliance on significant others can also enhance depressive symptoms particularly if the injured individual adopts a dependent framework of coping.²¹ Additional barriers to the SCI adjustment process include service access issues, family and community attitudes and vocational skills,^{18,22} although much of this cross-sectional data may not capture mood fluctuations over time in response to socio-environmental stressors, such as job maintenance.²³

Notably, imprecise definitions of depression confound this data. SCI studies have defined depression as a mood state, a collection of symptoms that frequently occur together, and a diagnosed psychiatric disorder.^{24,25} Consequently, various outcome measures have been utilised including self-report checklists of symptom severity which vary in their degree of specificity, and interview-based assessment tools which rely on clinician ratings of the person's chronic difficulties.^{11,25} In addition, varying depression cut-off scores have been adopted: some studies measure depression along a continuum (i.e. normal, mild, moderate and severe depression) whilst others categorise individuals into discrete groups (depressed vs non-depressed, high vs low depressive symptom severity).^{24,25} A better

understanding of depression chronicity, including its correlates, can be made by refining these measurement practices.²⁵

In summary, the association between psychosocial factors and post-SCI depression has been established however a key research question remains: which psychosocial construct has the strongest individual association with depression, both in the short and long-term? With no previous systematic review of this field having been conducted, the current review provides a reference point for comparing the relative importance of different psychosocial factors for the SCI population.

Materials and Methods

Literature search

Literature searches were carried out in the PsycINFO, PubMed and Embase databases. An electronic search strategy comprising a comprehensive list of key search terms relating to SCI (e.g. 'spinal injury', 'spinal cord trauma') and depression (e.g. 'depressive disorder', 'depressive symptoms', 'mood disorders') was developed for each database in accordance with the specific Thesaurus (PsycINFO), MeSH (PubMed) and Emtree (Embase) terms utilised by each (see Appendix A, available as supplementary material online: <http://www.maneyonline.com/doi/suppl/10.1179/2045772314Y.0000000295>). A research librarian was consulted as part of this search process. A broader search of the literature comprising a more general list of depression-related search terms (e.g. 'depression', 'depressive', 'adjustment') was also carried out in the Embase database in order to retrieve relevant studies. Although the literature in this review covered a broad range of journals reporting depression following SCI, specific journals were also targeted because of their connection to spinal rehabilitation: *Spinal Cord*, *The Journal of Spinal Cord Medicine*, *Topics in Spinal Cord Injury Rehabilitation* and *Spinal Cord Injury Nursing*. Reference lists of identified studies and relevant reviews^{24,25} were additionally examined in order to identify articles that may have been missed in the electronic searches.

Selection criteria

Eligible studies needed to include an adult sample (i.e. age ≥ 18 years) diagnosed with a traumatic or non-traumatic spinal cord injury, acquired either in adulthood or childhood. Outcome measurement was another criterion, with studies assessing depression as a primary or secondary outcome via a multi-item validated depression scale, structured diagnostic interview for depression, or a clinical diagnosis of depression.²⁵ The identification of depression could, therefore, be

determined by the presence of depressive affect (as measured by self-report) or professional evaluation, based on diagnostic criteria such as the Diagnostic and Statistical Manual of Mental Disorders.²⁵ Studies also had to report an association (Pearson correlation r) between depression and at least one multi-item psychosocial measure, or provide appropriate inferential statistics that could be used to identify an association (e.g. means, SDs). For the purpose of this review, psychosocial factors included individual psychological processes (i.e. cognitive, affective and behavioural) and factors related to the social environment (i.e. social support, service barriers)^{26,27}. Finally, eligible studies were published from 1970 until 2014 (i.e. when the term 'spinal cord injuries' was added as a Thesaurus term in the PsycINFO database) in the English language and in a peer-reviewed journal.²⁸

Studies were excluded if they did not specify an age range as part of their eligibility criteria or sample demographics. Where possible, authors of identified studies were contacted to clarify this detail. Studies were also ineligible if they included a heterogeneous sample of individuals with disabilities where data for the SCI group was not separately reported. Comprehensive mood scales which were not specifically designed to measure depression (e.g. General Health Questionnaire, Brief Symptom Inventory, Hospital Anxiety and Depression Scale), in addition to depression measures without psychometric data for SCI were also excluded, as per Kalpakjian's criteria.²⁵ Finally, studies were excluded if their data was based on the findings of non-parametric data or multivariate analyses (i.e. R^2 , unstandardised B and standardised β , structural equation modelling), the latter being problematic due to the use of different predictors and covariates.²⁹

The titles and abstracts of retrieved studies were initially reviewed against the eligibility criteria. A number of potentially relevant studies were subsequently identified, from which the full-text versions were then reviewed against the inclusion and exclusion criteria (list of excluded studies is provided in supplementary online material, <http://www.maneyonline.com/doi/suppl/10.1179/2045772314Y.0000000295>).

Retrieved studies were independently reviewed by each author, with discrepancies in review decisions reconciled through discussion and consensus. This resulted in 38 final studies.^{17,18,22,30-64}

Data collection and preparation

In accordance with available guidelines for reporting systematic reviews⁶⁵ a data extraction sheet was formulated (Table 1). The data extraction sheet detailed study

Table 1 Descriptive characteristics of included studies (*N* = 24 studies)

Country / reference	Sample characteristics						Outcome measures			
	N	Mean (SD) age in years	Mean (SD) years since injury	Injury type	Lesion	Recruitment source	Depression	Psychosocial	STROBE rating	
United States ^{22,30,31}	116	42.5 (11.6)	15.3 (11.3)	38 paraplegia 72 tetraplegia 6 unknown	46 complete 55 incomplete 15 unknown	Community	CES-D	Craig Hospital Inventory of Environmental Factors Perceived Social Support Scale	20	
UK ^{32,33,43,62}	189	59.4 (8.2)	36.0 (5.9)	91 paraplegia 61 tetraplegia 37 paraplegia or tetraplegia	–	Inpatient & Outpatient	CES-D	Perceived Stress Scale	24	
Australia ³⁴	60	36.2 (7.9)	11.9 (7.2)	30 paraplegia 30 tetraplegia	49 complete 11 incomplete	Community	PHQ	Schedule of Recent Events Vocational Identity	13	
USA ^{35,58}	100	56 (-)	–	67 paraplegia 33 tetraplegia	–	Community	CES-D	Social Support Scale Perceived Control Scale	15	
USA ^{36–40,45}	182	39.19 (13.5)	7.3 (10.3)	106 paraplegia 74 tetraplegia 2 unknown	–	Inpatient & Outpatient	IDD	Social Provisions Scale SCI Assertion Questionnaire Sickness Impact Profile Hope Scale Problem Solving Inventory	17	
USA ⁴²	104	38.6 (2.1)	7.9 (8.0)	57 paraplegia 47 tetraplegia	–	Inpatient	BDI	State Anxiety Inventory Rotters Internal- External Scale Situational Control of Daily Activities	20	
USA ^{42,57}	140	37.0 (11.5)	10.6 (7.8)	60 paraplegia 57 tetraplegia 23 paraplegia or tetraplegia	–	Community	CES-D	CHART Social Integration	21	
USA ⁴⁴	74	41 (10)	12.7 (9.8)	–	–	Community	CES-D	Coping Strategies Questionnaire Short-Form McGill Pain Questionnaire West Haven-Yale Multidimensional Pain Inventory	22	
USA ¹⁸	244	43.1 (14.2)	–	124 paraplegia 106 tetraplegia 14 unknown	91 complete 92 incomplete 61 unknown	Outpatient & Community	PHQ	Lorig Chronic Disease Self-Efficacy Environmental Rewards Observation Scale	23	
USA ⁴⁶	64	44.6 (11.7)	12.0 (10.8)	–	–	Outpatient	CES-D	Social Support Scale Perceived Stress Scale Isolation Index	18	
USA ⁴⁷	61	40.9 (16.7)	2.7 (5.7)	25 paraplegia 36 tetraplegia	22 complete 39 incomplete	Inpatient & Community	IDD	Satisfaction with Life Scale Mutual Communal Behaviours Scale	18	
China ⁴⁸	100	37.7 (11.8)	1.5 (-)	–	–	Inpatient & Outpatient	CES-D	Acceptance of Disability Scale Multidimensional Scale of Perceived Social Support	19	
USA ^{50,51}	97	40.4 (10.2)	12.4 (6.5)	–	–	Oupatient	OAHRMQ	Reciprocal Social Support Scale	21	
USA ⁵²	208	36 (-)	15 (–)	–	–	Inpatient	PHQ	Purpose in Life Scale Satisfaction With Life Scale Illness Perception Questionnaire	17	
Canada ⁵³	47	40.6 (12.6)	15.2 (11.7)	–	29 complete 18 incomplete	Outpatient & Community	CES-D	Short-Form-36 Mental Component	20	
Taiwan ⁵⁴	49	43.7 (11.7)	11.8 (9.2)	–	30 complete 19 incomplete	Community	CES-D	Lorig Chronic Disease Self-Efficacy Scale	21	

UK ^{49,55}	37	40.9 (-)	9.9 (-)	22 paraplegia 15 tetraplegia	27 complete 10 incomplete	Outpatient	BDI	State Anxiety Inventory COPE Short-form Social Support Questionnaire	18
USA ⁵⁶	165	55.0 (12.3)	17.9 (11.7)	-	-	Community	CES-D	Short-Form State-Trait Anxiety Inventory Satisfaction with Life Scale Short-Form Interpersonal Support Evaluation List Perceived Stress Scale Hassles Scale Acceptance of Disability Scale	25
USA ⁵⁹	107	33.04 (11.2)	0.13 (12)	48 paraplegia 59 tetraplegia	48 complete 59 incomplete	Inpatient	IDD	Attitudes Index Beliefs Scale Cognitive Beliefs Questionnaire	19
USA ⁶⁰	80	39.8 (14.3)	8.1 (7.2)	31 paraplegia 49 tetraplegia	-	Inpatient & Outpatient	CES-D	West Haven-Yale Multidimensional Pain Inventory Social Support Questionnaire	15
USA ⁶¹	70	46 (11.7)	8.1 (-)	33 paraplegia 37 tetraplegia	-	Community	CES-D	CHART Short-Form Social Integration Satisfaction with Life Scale	18
Canada ¹⁷	395	45.68 (14.1)	13.5 (10.4)	190 paraplegia 194 tetraplegia	148 complete 240 incomplete 7 unknown	Inpatient, Outpatient & Community	PHQ	Alcohol Use Disorders Identification Test Substance Abuse in Vocational Rehabilitation Screener	18
USA ⁶³	204	41.4 (13.7)	10.5 (10.0)	-	-	Outpatient & Community	PHQ	Profile of Mood States Illness Cognitions Questionnaire Pain Coping and Cognitions List	24
Netherlands ⁶⁴	279	51.1 (14.2)	11.8 (10.7)	152 paraplegic 14 tetraplegic 14 unknown	115 complete 157 incomplete 7 unknown	Outpatient	PHQ-9		17

Abbreviations: CES-D = Centre for Epidemiologic Studies Depression Scale; IDD = Inventory to Diagnose Depression; PHQ-9 = Patient Health Questionnaire-9; BDI = Beck Depression Inventory; OAHMQ = Older Adult Health and Mood Questionnaire; CHART = Craig Handicap Assessment Reporting Technique; USA = United States; UK = United Kingdom; — data not reported.

characteristics (i.e. lead author, date, country, sample size, outcome measurement) and sample characteristics (i.e. mean age, SD at assessment, injury level and severity). Data extraction was undertaken by the first author (RK).

Of the 38 studies, 21 utilised overlapping samples. These were subsequently counted as seven studies to ensure independence of the data,²⁹ resulting in a final number of 24 studies. Few studies used the same combination of depression measurement and psychosocial outcome. In addition to this methodological heterogeneity, the inter-related nature of the examined psychological and social constructs made it inappropriate to collapse the data in order to calculate mean effect sizes.²⁹ Nonetheless, the calculation of individual effect sizes enabled direct quantitative comparisons between different self-report measures of depression, allowing conclusions to be drawn regarding their impact on psychosocial outcome.

Statistical analysis

The correlation coefficient (r) served as the primary effect size for this review. This allowed statistically informed inferences to be made about the direction and magnitude of the relationship between two continuous measures: depression and psychosocial outcome. The calculation of r proceeded in several stages. First, Pearson's correlation coefficient for each relationship between a standardised measure of depression and a standardised psychological or social measure utilised in a study was obtained. Notably, all identified studies provided r ; therefore, no r conversions were necessary. Second, if more than one study reported an association between the same measure of depression and same psychosocial outcome, an average correlation was obtained. This involved an r -to- Z transformation (Fisher's Z).^{66,67} Transformed values were then averaged and back transformed to an r in order to produce a pooled r for that psychosocial measure. Cohen's guidelines⁶⁸ (1992) were utilised to evaluate the magnitude of effect sizes, with effects of 0.10, 0.30 and 0.50 representing small, medium and large associations, respectively. Fourth, 95% confidence intervals (CIs) were calculated for each r in order to determine the range of r values likely to capture the population mean with a reasonable degree of certainty.⁶⁹ CIs that include the value of 0 are considered non-significant.⁶⁹ Finally, for ease of data interpretation and analysis, r s were categorised in accordance with the International Classification of Functioning Disability and Health (ICF) core sets for SCI and psychology^{27,28}: *personal factors*, which include a broad range of cognitive, behavioural and affective issues across five sub-domains (cross-cutting

or overall adjustment, thoughts and beliefs, patterns of behaviour, feelings, motives); *activities and participation* (i.e. relating to one's involvement in community, social and civic life); and *environmental* factors (i.e. relating to the physical, social and attitudinal environment).

Fail-safe N_s (N_{fs}) were additionally calculated for both individual and pooled r s in order to address the 'file drawer problem' inherent in scientific research: the practice of reporting and publishing only statistically significant results.⁷⁰ N_{fs} statistics estimate the number of unpublished studies citing non-significant results (e.g. $r \leq 0.10$) that would need to exist in order to render an observed effect size non-significant. The higher the N_{fs} value, the more likely that r is robust.

These combined calculations informed the conclusions drawn from this review. Specifically, a psychological or social measure was considered a significant correlate of depressed mood post-SCI if it produced a medium to large effect (i.e. $r \geq 0.30$) and was statistically significant (i.e. 95% CIs did not span 0). The results were considered in the context of publication bias.

Reporting quality

Included studies were each evaluated against the Strengthening the Reporting of Observational Studies in Epidemiology statement (STROBE).^{71,72} For the purpose of this review, a scoring system was applied to the STROBE with each item critically appraised and scored as 1 (present) or 0 (absent or partial detail provided). Items scores were then summed to reveal an overall reporting quality score (total score range: 0–32). These evaluations were independently conducted by each author, with correlations between total STROBE scores revealing good inter-rater agreement ($r = 0.89$, $P < 0.01$). Consultation and consensus ratings were subsequently made (Appendix B, supplementary material online).

Results

Study characteristics

Sample sizes varied from small subgroups of individuals living in the community to national datasets such as the SCI Model Systems. All studies were observational in design and relied on self-report methodology. This included measures of depression severity (i.e. Centre for Epidemiologic Studies Depression Scale, CES-D; Beck Depression Inventory, BDI) and diagnostic screening tools (Patient Health Questionnaire, PHQ; Inventory to Diagnose Depression, IDD; Older Adult Health and Mood Questionnaire, OAHMQ) in addition to 43 standardised psychosocial outcomes.

Participant characteristics

A pooled sample of 3172 adults with SCI provided data for this review (Table 1). The mean age was 43 (SD = 6.6, range 18–88 years) and the majority of participants were male (68%, $n = 2177$), although one study did not provide this detail.⁴⁸ Average time since injury was 11 years (SD = 7.4, $N = 22$ studies). This included participants with recent onset SCI and those living with SCI for an extended period of time (range = 1 month to 10 years). Details relating to injury level and completeness were inconsistently reported, as were ethnicity ($N_{studies} = 14$), marital status ($N_{studies} = 14$), pre-injury education level ($N_{studies} = 19$) and employment status at time of assessment ($N_{studies} = 13$). Where vocational data was available, variable definitions were adopted including discrete (e.g. employed vs. unemployed) or multiple categories (e.g. part-time vs. full-time vs. student vs. unpaid productive activities) and continuous data (e.g. average income).

Eleven studies applied threshold cut-off scores to report the prevalence of probable major depression. The pooled average depression prevalence across these studies was 37% (SD = 15.7). This included an average estimate of 40% for the CES-D (SD = 17.4; cut-off score ranging from 10 to > 16),^{42,44,46,48,53,54,56,57} 38% for the BDI (cut off score of 14),⁴⁹ 23% for the PHQ (score > 10),⁵² and 27% for the OAHMQ.⁵⁰

Reporting quality of studies

The mean STROBE score was 19 of a maximum 32 (SD = 2.9, range = 13–25; Table 1 and Appendix B supplementary material online). All studies provided empirical and theoretical rationale for their objectives, however methodological and statistical detail varied. This included limited information relating to sources of bias, although some studies ($N_{studies} = 9$) partially addressed this by acknowledging potential selection biases in participant recruitment. Other details not generally reported included a-priori or post-hoc power to justify sample representativeness, sensitivity analyses to rule out the possible impact of outliers on a dataset, and the management of missing data. Two studies incorporated ratio measures to identify depression risk factors: employment status²² and alcohol use.⁶²

Cross-sectional psychosocial correlates of depression

Significant medium to large effects were observed across all ICF domains (Table 2). Individual *personal* variables demonstrated the strongest association with depression symptomatology. This included feelings of worry, tension or apprehension (as measured by the State

Table 2 Cross-sectional data on depression correlates ($N_{\text{studies}} = 22$)

ICF domain	Psychosocial measure		Depression measure	N_{studies}	$N_{\text{participants}}$	r	95% CI		N_{fs}
	Scale	Subscale					Lower	Upper	
Personal									
Feelings	State Anxiety Inventory		CES-D ⁵⁶	1	165	0.80	0.74	0.85	10
			BDI ⁴¹	1	104	0.58	0.44	0.70	6
	Profile of Mood States	Anger	PHQ-9 ⁶⁴	1	279	0.57	0.49	0.64	6
	Short-Form-36	Mental component	CES-D-20 ⁵³	1	47	0.56	0.33	0.73	5
			CES-D-10 ⁵³	1	47	0.56	0.33	0.73	5
Cross-cutting	Sickness Impact Profile	Psychosocial	IDD ^{36-40,45}	1	156	0.72	0.64	0.78	8
	Satisfaction With Life Scale		CES-D ⁵⁶	1	165	-0.65	-0.73	-0.55	9
			IDD ⁴⁷	1	61	-0.55	-0.70	-0.35	7
			PHQ-9 ^{17,52}	2	604	-0.39	-0.46	-0.32	10
	Acceptance of Disability Scale		CES-D-10 ⁴⁸	1	100	-0.57	-0.69	-0.42	8
			IDD ⁵⁹	1	107	-0.28	-0.45	-0.10	4
	Schedule of Recent Events		PHQ-9 ³⁴	1	60	0.35	0.11	0.55	5
Thoughts and beliefs	Attitudes Index		CES-D ⁶⁰	1	80	0.61	0.45	0.73	6
	Beliefs Scale		CES-D ⁶⁰	1	80	-0.58	-0.71	-0.41	8
	Perceived Control Scale		CES-D ³⁵	1	100	-0.56	-0.68	-0.41	7
	Hassels Scale		CES-D ⁵⁶	1	165	0.51	0.39	0.61	5
	Illness-Cognition	Helplessness	PHQ-9 ⁶⁴	1	279	0.48	0.38	0.57	4
		Acceptance	PHQ-9 ⁶⁴	1	279	-0.39	-0.49	-0.29	5
		Disease beliefs	PHQ-9 ⁶⁴	1	279	-0.26	-0.37	-0.15	4
	Cognitive Beliefs Scale		CES-D ⁶⁰	1	80	0.47	0.28	0.63	6
	Lorig Self-Efficacy Scale		PHQ-9 ¹⁸	1	244	-0.58	-0.66	-0.49	7
			CES-D-10 ⁵⁴	1	49	-0.46	-0.66	-0.21	6
Thoughts and beliefs	Vocational Identity		PHQ-9 ³⁴	1	60	-0.38	-0.58	-0.14	5
	Situational Control of Daily Activities		BDI ⁴¹	1	104	-0.36	-0.52	-0.18	5
	Hope Scale	Pathways	IDD ^{36-40,45}	1	57	-0.36	-0.48	-0.02	5
		Agency	IDD ^{36-40,45}	1	57	-0.19	-0.33	-0.05	3
	Illness Perception Scale	SCI perceptions	PHQ-9 ¹⁷	1	208	-0.17	-0.30	-0.04	3
		Hope for recovery	PHQ-9 ¹⁷	1	208	-0.07	-0.20	0.07	2
	Rotters Internal-External Scale		BDI ⁴¹	1	104	0.23	0.04	0.40	1
Patterns of experience and behaviour	Coping Strategies	Catastrophizing	CES-D ⁴⁴	1	74	0.64	0.48	0.76	7
	Substance Abuse in Vocational Rehabilitation	Substance abuse	PHQ-9 ⁶³	1	204	0.57	0.47	0.66	6
		Alcohol misuse	PHQ-9 ⁶³	1	204	0.50	0.39	0.60	5
		Drug misuse	PHQ-9 ⁶³	1	204	0.50	0.39	0.60	5
	Pain Coping and Cognition	Catastrophizing	PHQ-9 ⁶³	1	279	0.55	0.46	0.63	5
		External control	PHQ-9 ⁶⁴	1	279	0.14	0.02	0.25	0
		Internal control	PHQ-9 ⁶⁴	1	279	-0.09	-0.21	0.03	2
		Pain coping	PHQ-9 ⁶⁴	1	279	-0.05	-0.17	0.07	2
	Problem Solving Inventory		IDD ^{36-40,45}	1	90	0.50	0.38	0.60	5
	AUDIT		PHQ-9 ⁶³	1	204	0.33	0.20	0.45	2
	SCIAQ		IDD ^{36-40,45}	1	156	0.14	-0.01	0.28	0
Motives	Purpose in Life		PHQ-9 ¹⁷	1	208	-0.44	-0.54	-0.32	6
Activities and Participation	Environmental Rewards Observation Scale		PHQ-9 ¹⁸	1	244	-0.68	-0.74	-0.60	9
	Isolation Index		CES-D ⁴⁶	1	64	-0.50	-0.66	-0.28	6
	CHART	Social integration	CES-D ^{42,57}	1	140	-0.25	-0.40	-0.08	4
			PHQ-9 ¹⁷	1	395	-0.04	-0.14	0.06	1

Continued

Table 2 Continued

ICF domain	Psychosocial measure		Depression measure	<i>N</i> _{studies}	<i>N</i> _{participants}	<i>r</i>	95% CI		<i>N</i> _{fs}
	Scale	Subscale					Lower	Upper	
Environmental	Social Support Scale		CES-D ⁴⁶	1	64	-0.52	-0.68	-0.31	7
		Satisfaction with amount	CES-D ^{35,61}	2	170	-0.34	-0.47	-0.20	9
		Satisfaction with quality	CES-D ^{35,61}	2	170	-0.42	-0.54	-0.29	10
	Short-Form Interpersonal Support Evaluation		CES-D ⁵⁶	1	165	-0.51	-0.61	-0.39	7
	West Haven-Yale Multidimensional Pain	Negative	CES-D ⁶¹	1	70	0.49	0.29	0.65	6
		Distracting	CES-D ⁶¹	1	70	0.20	-0.04	0.42	1
		Sollicitous	CES-D ^{44,61}	2	164	0.16	-0.09	0.39	1
	Multidimensional Scale of Perceived Social Support		CES-D-10 ⁴⁸	1	100	-0.45	-0.59	-0.28	6
	Craig Hospital Inventory of Environmental Factors		CES-D ^{22,30,31}	1	116	0.41	0.25	0.55	3
	Perceived Social Support Scale		CES-D ^{22,30,31}	1	116	-0.40	-0.54	-0.23	5
	Social Provisions Scale	Reassurance worth	IDD ^{36-40,45}	1	182	-0.39	-0.51	-0.26	5
		Social integration	IDD ^{36-40,45}	1	182	-0.35	-0.47	-0.22	5
		Social attachment	IDD ^{36-40,45}	1	182	-0.28	-0.41	-0.14	4
		Guidance	IDD ^{36-40,45}	1	182	-0.28	-0.41	-0.14	4
		Reliable alliance	IDD ^{36-40,45}	1	182	-0.26	-0.39	-0.12	4
		Nurturance	IDD ^{36-40,45}	1	182	-0.09	-0.23	0.06	2
	Reciprocal Social Support Scale		OAHM ^{50,51}	1	97	-0.24	-0.42	-0.04	4
	Mutual Communal Behaviours		IDD ⁴⁷	1	61	-0.17	-0.40	0.08	3

Abbreviations: *N*_{studies} = number of studies contributing to the effect size *r*; *N*_{participants} = number of participants; *r* = Pearson's correlation coefficient; 95% CI = confidence interval for *r*; CHART = Craig Handicap Assessment Reporting Technique, AUDIT = Alcohol Use Disorders Identification Test, SCIAQ = SCI Assertion Questionnaire
 Values in bold indicates significant effect: $r \geq 0.30$; 95% CI $\neq 0$.

Anxiety Inventory), anger (Profile of Mood States) and poor mental health in general (Short Form 36). Broader cross-cutting effects were also noted in terms of reduced quality of life (Sickness Impact Profile, Satisfaction with Life Scale, Schedule of Recent Events), and disability acceptance.

Depressive individuals, invariably, reported negative thoughts and beliefs including learned helplessness (Attitudes Index, Illness Cognitions Scale), lowered self-efficacy and self-control (Beliefs Scale, Lorig Self-efficacy Scale, Situational Control of Daily Activities), distorted representations of SCI-related disability (Cognitive Beliefs Scale), heightened stress (Hassles Scale), fewer vocational interests and skills (Vocational identity Scale) and a reduced sense of hope (Hope Scale). Dysfunctional patterns of experience and behaviour, including pain catastrophising (Coping Strategies Scale, Pain Coping and Cognition Scale), alcohol and

drug misuse (Substance Abuse in Vocational Rehabilitation, Alcohol Use Disorders Identification) and reduced problem-solving abilities (Problem Solving Inventory), in addition to motivational factors, demonstrated medium associations with self-reported depression.

Community activities and participation were also adversely affected, with significant negative correlations noted between depression scores and degree of enjoyment or fulfilment from experiences or hobbies (Environmental Rewards Observation Scale), and feelings of social isolation. In relation to environmental factors, persons with higher depression ratings reported greater dissatisfaction with the quantity and quality of available social and community supports. This included the degree to which spouses or significant others displayed negative responses to one's pain behaviors and complaints (Westhaven-Yale Multidimensional Pain).

These results need to be interpreted cautiously given the associated small N_{fs} values, which were primarily calculated from single studies.

Longer-term psychosocial correlates of depression

Two longitudinal studies were included, incorporating assessments at 3 to 10 years post SCI (Table 3). Significant and medium to large effects were noted across ICF domains, suggesting that depression symptoms continued to negatively impact on psychosocial outcomes in the longer term. This included diminished *personal* resources: higher perceived stress levels, feelings of anxiety, and difficulty coping with the challenges associated with one's injury. Depression self assessment was also associated with reduced *socio-environmental* resources, namely low social support levels. Notably, individuals who scored highly on the BDI at week 12 post-SCI were likely to score high at their 10 year follow-up assessment.^{49,55} However, the sparse dataset limits the generalisability of these findings.

Discussion

The present systematic review evaluated the observational data for 3,172 adults with an acquired SCI to identify the strongest psychosocial correlates of depression post injury. Individual measures relating to personal psychological processes, environmental barriers and services, and degree of social activity and participation demonstrated medium to large associations with depression—both in the acute and chronic stages of SCI. However, further data analyses were limited, with sociodemographic characteristics (e.g. post-injury employment)^{8,23} that may create an environment in which psychological outcomes, including depression, are likely to co-exist, inconsistently reported across studies.

The present findings support recent literature positing that psychological difficulties, such as anxiety, may reinforce depressive thoughts and beliefs for a subset of individuals with a newly acquired injury.^{6,73,74,75} The results also concur with over-arching findings that secure relationships with friends and family, along with improved accessibility and availability of SCI resources in the community can significantly influence mood.^{19,20} Whilst locus of control orientation (as measured by Rotter's Internal-External Scale) was not an important variable for this sample, other cognitive variables including pain-related self-efficacy and catastrophising were significantly associated with probable depression.^{44,64,74,75} Similarly, social isolation and depression were significantly related, although a standardised measure of community and social integration, the Craig Handicap Reporting and Assessment Technique (CHART), demonstrated a small and non-significant association with depression. This discrepancy may, in part, be attributable to the CHART's psychometric properties having been critiqued for its reliance on normative social roles without consideration of an individual's activity preferences.⁷⁶

The current findings have important implications for clinical practice and research. The suggestion is that early intervention and prevention strategies which focus on the assessment and management of psychosocial risk factors that increase vulnerability to mental health issues are critical in limiting the impact of SCI-related depression.⁷⁷ Such interventions might include Coping Effectiveness Training, which builds on emotion and problem-focused coping skills.^{78,79} More recently, mindfulness based approaches have demonstrated effectiveness with pain-related disability,^{80,81} although the application of third wave therapies to SCI requires further evaluation. The longitudinal data

Table 3 Longitudinal data on depression correlates ($N_{studies} = 2$)

ICF domain/ reference	Psychosocial measure		Depression measure	$N_{studies}$	$N_{participants}$	Time interval (yrs)	r	95% CI		N_{fs}
	Scale	Subscale						Lower	Upper	
Personal										
Thoughts and beliefs ^{32,33,43,62}	Perceived Stress Scale		CES-D	1	187	3	0.65	0.56	0.73	6
			CES-D	1	187	6	0.71	0.63	0.77	6
Feelings ^{49,55}	State Anxiety Inventory		BDI	1	37	10	0.59	0.33	0.77	7
Patterns of experience and behaviour	COPE	Suppression of competing activities	BDI	1	37	10	0.42	0.11	0.65	5
Environmental	Social Support Scale	Satisfaction	BDI	1	37	10	-0.45	-0.68	-0.15	6

also suggests that without the skills and resources to effectively manage SCI-related distress there is a greater risk of developing comorbid psychiatric conditions such as substance abuse. It follows that at-risk persons will benefit from routine psychological evaluation and monitoring to meet their mental health needs over time.^{73,77} Early psychoeducation on mental health issues can also help to maintain client awareness and service engagement, with misconceptions and/or social stigma about mental health issues significantly contributing to early withdrawal from psychological and psychiatric treatment.⁸²

The association between depression and the amount and quality of support from friends and family underlines the importance of stable, reassuring social networks in the SCI rehabilitation process. Training programs with a focus on general and disability-specific social skills have been shown to contribute to proactive coping behaviours post-SCI.⁸³ The involvement of significant others in this skills training is also critical in helping to reinforce the strategies needed to build and maintain strong relationships and, potentially, reduce vulnerability to depression for both caregivers and care recipients.⁸⁴ Similarly, the finding that a reduced perception of one's vocational goals and skills is related to depression highlights a role for vocational skills training aimed at meaningful employment outcomes early in the rehabilitation process.²³

Methodological limitations

A number of limitations must be considered when interpreting the results. First, the data search may have failed to identify all relevant studies. The issue of missing data poses a major problem in systematic reviews as it compounds the risk of deficient conclusions.⁸⁵ Importantly, a broad search of the SCI literature was conducted, with both SCI and adjustment-related terms utilised in addition to the reference lists of eligible studies being examined.⁸⁵ Given that the data search was, however, restricted to published studies the findings may have been undermined by publication bias. This limitation was partly addressed by calculating fail-safe *N* statistics, which provide a valuable indication of the strength of an observed finding relative to the strength of the evidence for publication bias.

Second, few effect size *r* estimates were based on multiple studies, which are considered to be far more reliable than estimates based on single studies.²⁹ However, the examination of individual studies was necessary due to the limited overlap in the psychosocial measures utilised by the identified studies in addition to the heterogeneity inherent in the SCI population.²³ Importantly, this

micro-analysis of effect size data provided detail relating to the dispersion of effect sizes; detail which can be overlooked when data is synthesised.²⁹

Third, given that the examined studies relied on psychometric evaluation, the examined associations only reflect psychosocial correlates of probable, rather than clinical diagnosis of depression. Indeed, self-report measures of depression can overestimate an individual's symptomatology.^{24,25} Notably, validated scales including the PHQ and IDD—both of which are based on diagnostic criteria—were included in this review.^{24,25} Nonetheless, future studies would benefit from utilising clinician-based assessments to supplement self-report ratings of depression.^{24,25}

Fourth, there are issues stemming from the reliance on large datasets across a number of the included studies. The Model Systems programs provide an opportunity to conduct sufficiently powered research for a low prevalence condition such as SCI.⁸⁶ However this practice can complicate systematic research due to the significant overlap between and across SCI studies. Importantly, studies that utilised overlapping samples were combined for the purpose of this review, ensuring that no single study contributed a disproportionate amount of data to the calculation of effect size *r*.²⁹

Finally, the review relied primarily on cross-sectional and bivariate data, limiting any causal interpretations. Further longitudinal research incorporating assessments of psychosocial functioning at various time points are therefore needed to map the longer-term trajectory of coping for this group. Moreover, there is evidence that multivariate frameworks best capture the multi-faceted nature of SCI, with covariates such as anger, self-efficacy and socio-economic status helping to explain temporal changes in depression symptomatology for individuals with traumatic injuries.⁷⁷ Meta-analytic techniques are evolving to address the complex statistical methods required by multivariate data, although this is still dependent on the consistency of within-study data.⁸⁷

Conclusion

This systematic review highlights the significant association between depression symptomatology post-SCI and impairments across ICF domains. It follows that thoughts, feelings and behaviours impacting on SCI adjustment can be targeted through multidisciplinary rehabilitation interventions. Further longitudinal research will help to confirm whether depression correlates change over time and help guide effective treatments to enhance longer-term psychosocial adjustment.

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Disclaimer statements

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**Studies included in the review*