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REVIEW

Anxiety prevalence following spinal cord injury: a meta-analysis

This article has been corrected since Advance Online Publication and a corrigendum is also printed in this issue.

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Study design: Meta-analysis.
Objectives: Prevalence estimates indicate that anxiety following spinal cord injury (SCI) is a common problem. However, methodological differences between studies may impact the clinical interpretation of these data.
Methods: Data from 18 independent studies ($N_{participants} = 3158$), which reported the prevalence of an anxiety disorder or associated symptoms, were identified from the Embase, PubMed and PsycInfo databases. Proportions were the primary effect size estimate. Confidence intervals, fail-safe *N*s and the I^2 statistic were additionally calculated to identify the extent to which findings were robust and consistent across studies.
Results: Five per cent of participants met the criteria for either GAD or panic disorder, with Agoraphobia identified in 2.5%. These diagnostic data were, however, limited to two studies. Higher rates were noted for self-reported 'caseness' of anxiety, with 27% reporting clinically significant symptoms. Anxiety prevalence estimates varied across the individual self-report measures (range: 15–32%). Method of administration (range: 26–32%) did not impact significantly on these estimates nor did recruitment source, with similarly high anxiety levels reported by hospital (27%) and community (29%) samples.
Conclusions: Early identification and treatment of anxiety are important in SCI rehabilitation, with a subgroup of individuals experiencing chronic symptoms. Further research is needed to establish guidelines for the interpretation of self-report data, including the use of clinical cutoffs.
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INTRODUCTION

Anxiety is problematic for adults with an acquired spinal cord injury (SCI), with up to 45% of injured individuals reporting excessive worry, fear or panic,[1] contributing to a high risk of experiencing disorders such as generalised anxiety (GAD).[2] Heightened distress may be triggered by the traumatic nature of some SCIs,[3,4] the ongoing fear of secondary life-threatening consequences (for example, autonomic dysreflexia[5]), or pre-injury psychological morbidity.[2,6] Notably, the SCI and anxiety research is characterised by wide ranging prevalence estimates, thereby limiting the interpretation of these data. Accurate and early assessment of psychological distress following SCI is important, as clinically relevant symptoms can undermine functional recovery[7,8]

Discrepancies in anxiety estimates post SCI may, in part, be explained by the differing definitions, and subsequent measurements, employed. This includes specific cognitive, affective, behavioural and physical symptoms consistent with established diagnostic nomenclature (for example, Diagnostic and Statistical Manual of Mental Disorders (DSM)[9]). Clinical diagnoses are associated with lower prevalence estimates as they allow the distinction of symptoms solely attributable to a severe mental illness from that of a neurological disorder such as SCI.[10,11] In saying this, the refined diagnostic criteria of DSM-5, which include removal of the requirement that individuals recognise that their anxiety is excessive and the reclassification of posttraumatic stress disorder and obsessive compulsive disorders into separate categories,[9] may impact on prevalence estimates reported by recent SCI studies.

In comparison to diagnostic data, anxiety self report measures can artificially inflate prevalence estimates. For example, the Beck Anxiety Inventory incorporates somatic symptoms that may overlap with secondary complications commonly experienced following a SCI, such as problems with temperature regulation, blood pressure, respiratory functioning and motor weakness.[12]

When utilising a self-report measure, the issue of intentional or unintentional self-report bias needs to be considered. In a diagnostic interview, a patient may under-report symptoms due to stigma surrounding mental illness. Indeed, individuals with SCI have been shown to internalise stigma, reporting feelings of shame and embarrassment about their physical disability and subsequent coping.[13] In comparison, the level of anonymity offered by a self-administered measure may help reduce any discomfort experienced when revealing sensitive information regarding psychological symptoms.[12] However, there is also evidence that self-report surveys can lead to an underestimation of the true rates of mental illness among the general community, due to socially desirable responding.[14]

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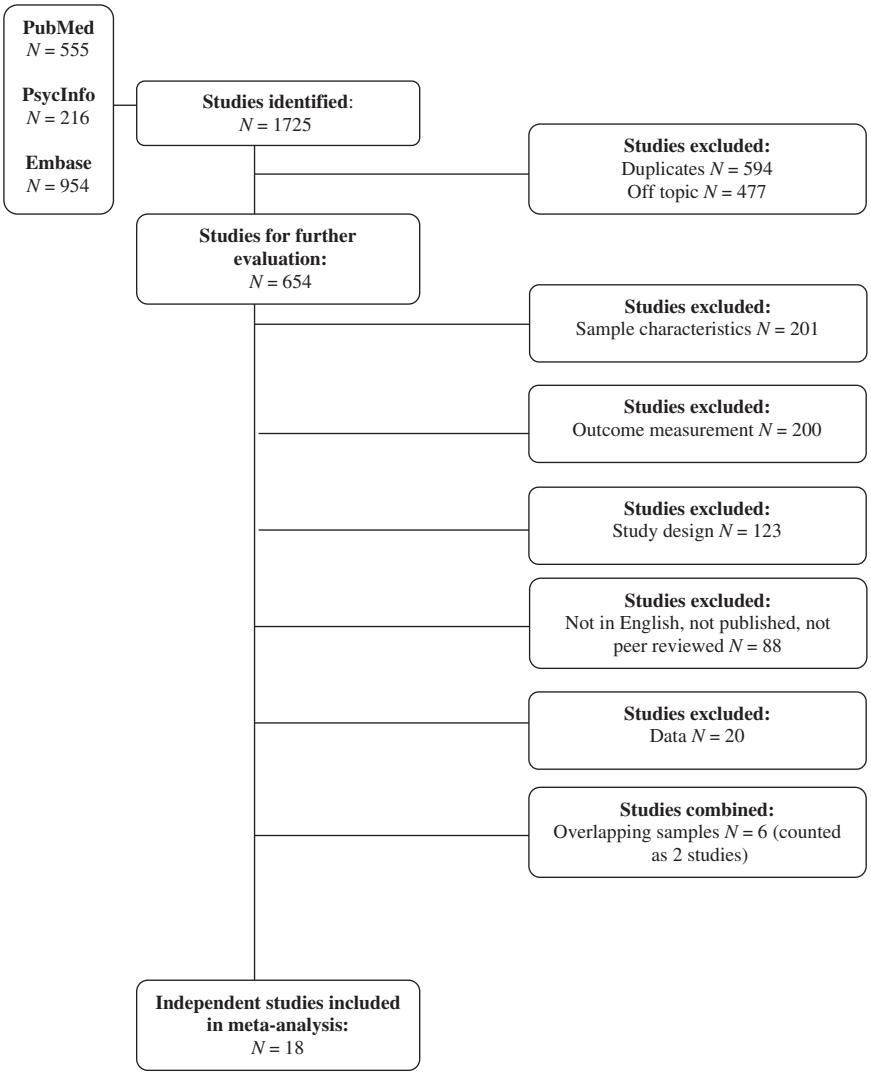

Figure 1 Flow chart of study selection process.

The timing of assessment is a further confound, with psychological adjustment following SCI characterised as a dynamic and an individualised process.[15,16] This might include a significant increase in mean anxiety levels during the early stages of rehabilitation or even continuing symptoms up to 10 years post injury.[17] Differing patterns of recovery, including a temporal decrease in general psychological distress as well as a stable trajectory characterised by minimal symptoms of distress over time, have also been identified among traumatic injury groups.[15,18] In combination, these findings suggest that psychological assessments administrated at various stages of the rehabilitation process are likely to yield different point prevalence estimates for probable anxiety.

Findings from SCI studies on anxiety prevalence must, therefore, be interpreted within the context of methodological differences. A quantitative review of existing data is needed to help clarify the influence of measurement type, method of administration and recruitment source on prevalence rates and, in turn, assist in the accurate identification of mental health problems post-injury. The objective of the present study is to evaluate the available literature, using meta-analytic techniques, to provide an accurate estimate of anxiety disorders and symptoms among adults with an acquired SCI.

MATERIALS AND METHODS

Literature search

An electronic search of the Embase, PubMed and PsycINFO databases was undertaken to obtain studies that reported the prevalence of anxiety following SCI. The search strategy involved a comprehensive list of key terms relating to SCI (for example, 'spinal injury', 'spinal cord trauma', 'paraplegia'), anxiety (for example, 'anxiety disorder', 'anxiety symptoms') and general psychological adjustment (for example, 'mental disorder', 'psychological adjustment', 'psychological distress') to ensure that all relevant studies were obtained (see Appendix A). Consultation with a research librarian ensured that correct search processes were undertaken.

Eligibility criteria

For a study to be included in this meta-analysis, it needed to include an adult sample (that is, age $\geqslant$ 18 years), diagnosed with traumatic or non-traumatic SCI acquired in adulthood or childhood. Studies needed to provide proportion estimates of state anxiety based on a standardised diagnostic interview schedule or self-report measure with established cutoff scores for 'caseness'. Current DSM 5 categories of anxiety disorder were considered for this meta-analysis only. This included specific phobias, social phobia, panic disorder, agoraphobia and GAD.[9] Studies also had to be published in English from 1970 (coinciding with the publication of the DSM II, which eliminated the concept

of mental disorders being a result of personality influenced 'reactions') to August 2015.

Studies were ineligible if they included children or adolescents with a SCI (that is, <18 years), given that the experience of psychological symptoms may be influenced by developmental stages.[19] Veterans with a SCI were also excluded as the additive effect of prior trauma may inflate symptoms of distress (particularly intrusive thoughts), thereby complicating psychological recovery.[20] Studies were also ineligible if they utilised measures of trait anxiety (that is, Eysenck Personality Questionnaire) or global measures of distress that were not purposely designed to assess anxiety (for example, Kessler Psychological Distress Scale). Finally, qualitative studies and grey literature (for example, dissertations, conference proceedings) were excluded.

A total of 1725 studies were initially identified in the search process (see Figure 1). An examination of the titles and abstracts of each article against the aforementioned inclusion and exclusion criteria resulted in a pool of 654 potentially eligible articles. The full-texts of these studies were subsequently examined by both authors.[1,8,21–40] The reference lists of these studies and published SCI review papers[2,10,11,41] were additionally examined. Although this process did not lead to the discovery of any new studies, it helped ensure that all relevant papers were identified. As data used for a meta-analysis should be sourced from independent samples, the studies were also checked so that there was no overlap in the samples utilised.[42] Six studies[25,30–34] were subsequently pooled into two studies. Specifically, only the study providing the largest sample size was included. In the case of the study by Kennedy *et al.*,[27] which involved 14 observational points, only the data from the final wave of data collection were utilised as the earlier sample cohorts did not meet the age criterion for this meta-analysis (that is, ⩾18 years). Anxiety data were provided for a subsample of January's[26] longitudinal analysis. For this same reason, a subgroup of individuals with paraplegia was examined from the study by Nestoros.[35] The study by Craig *et al.*[23] was one of the few studies that provided diagnostic data based on clinical interview, hence variations in time point assessments were additionally examined. The final sample comprised of 18 independent studies.

Data collection and preparation

In accordance with the Meta-analysis of Observational Studies in Epidemiology (MOOSE) guidelines,[43] information from each study was collated using a standardised form (see Appendix B). This included study details (for example, year of publication) and sample demographic and injury characteristics (for example, mean age, injury details). Studies were further classified according to outcome measurement (diagnostic interview vs self-report), recruitment source (hospital, community or a combination of both) and method of administration (self-administration via online, postal survey, at a clinic in the absence of a clinician, and/or face-face verbal interview). The two authors (JL and DD) independently extracted the data in duplicate, with disagreements resolved by consensus.

Statistical analysis

Effect size data were entered into Comprehensive Meta-Analysis (CMA) Software for analysis (Version 3, Biostat Inc, Englewood, NJ, USA). The current study utilised proportions to summarise the prevalence of anxiety disorders and symptoms (based on cutoff criteria for 'caseness'). If a single study provided multiple measures of anxiety or multiple assessment points, prevalence estimates were averaged to ensure that each study contributed one effect size to any pooled analysis.

Pooled mean prevalence rates were calculated by weighting individual effects by their inverse variance, or inverse of the squared s.e.[44] This ensures that more precise studies (that is, larger studies with smaller sampling variance) are weighted higher as their results are considered to be more reliable.[44] Forrest plots were generated to illustrate different distributions of effect sizes and to identify data outliers (that is, estimates that were extreme or well-separated from the rest of the data). Ninety-five per cent confidence intervals (95% CIs) and *P*-values were additionally calculated to determine the statistical significance of both individual and weighted effect sizes. In the current study, the CIs provided the upper and lower bounds within which one can be 95% confident that the true prevalence for post-SCI anxiety lies.

To address the problem of publication bias, or the overestimation of an effect size due to a reliance on published data, fail-safe *N* statistics (N_{fs}) were calculated for both individual and weighted proportions.[42] The calculation of N_{fs} requires a criterion value that equates to a minimal or a clinically insignificant finding. For this purpose, criterion values based on DSM-5[9] prevalence estimates for anxiety (that is, 3%) were utilised. Generally, the larger the N_{fs} value, the more robust the findings. In this meta-analysis, a N_{fs} was deemed to be sufficient if it exceeded the number of studies that contributed to a pooled effect size.

The I^2 statistic was used to identify the percentage of variation across studies due to inter-study heterogeneity rather than sampling error.[45] The lower the I^2 value, the more likely that true effect sizes are consistent across studies.[46]

For these statistics, a random-effects model, which estimates the mean of a distribution of effects, was adopted. This model takes into account the notion that studies differ because of sampling error and study design.[42,44]

Following the examination of overall effect sizes for individual studies, subgroup analyses were conducted to explore the effect of methodological variables on prevalence estimates, specifically measurement type (that is, diagnostic interview vs self-report), recruitment source (that is, hospital vs community) and method of test administration (for example, self-administration by postal or online questionnaire or at a clinic vs interview).

RESULTS

Study characteristics

The 18 independent studies included in this meta-analysis provided data for 3158 adults with an acquired SCI (see Tables 1 and 2). Studies provided a cross-cultural perspective on anxiety prevalence, with participants sourced from Australia ($N_{studies}=5$), UK ($N_{studies}=3$), USA ($N_{studies}=2$) and Canada ($N_{studies}=2$) in addition to single studies from Europe and West Asia. Most studies ($N_{studies}=15$) were cross-sectional in design and involved convenience or purposive sampling from single SCI units. Three multicentre trials contributed to 59% of the sample.[26,30,40]

Sample characteristics

Consistent with global patterns of SCI,[47] the majority of participants were middle aged and male (Table 2). Most had longstanding SCI, having lived with their injury for an average of 9 years (range: 2 months to 66 years), with January *et al.*[26] examining adults with paediatric-onset SCI. Traumatic SCIs were the most common aetiology, with four studies[4,27,35,39] specifically recruiting this subgroup. Additional details relating to injury type, aetiology or lesion completeness were not consistently reported. An early study by de Carvalho *et al.*[24] did not utilise international standards for SCI neurological classification (that is, F Grading, AIS), whereas other authors noted that these subgroup data were missing or not available. Similarly, socio-contextual information that may contribute to psychological distress was not consistently provided. For example, educational and occupational status were reported as continuous (that is, mean years of schooling) or ordinal data (for example, primary, secondary, tertiary vs high school; employed vs unemployed). Exclusion criteria included individuals with a head injury (type not specified) and those with chronic physical or psychological comorbidities (for example, cardiovascular disease, diabetes mellitus, rheumatic disease and psychosis). Four studies[23,26,29,30] identified adjunct treatments (that is, psychotropic medication prescription), which may impact prevalence estimates for anxiety.

Prevalence of anxiety

Diagnostic interview. DSM-IV diagnoses, based on the MINI Neuropsychiatric Interview, were provided by two studies (Figure 2).[1,23] This included a weighted prevalence estimate of 5.4% for GAD, 5%

Table 1 Summary of SCI studies measuring anxiety ($N_{studies} = 18$)

Lead author (date)	*Sample details*			*SCI details*						*Anxiety measure*
	Country	*Total* N *(Male/female)*	*Mean age (s.d.) Range*	*Mean time since injury (s.d.) Range*	*SCI cause*	*SCI type (*N*)*		*SCI lesion (*N*)*		
						Paraplegia	*Tetraplegia*	*Complete (AIS A)*	*Incomplete (AIS B,C,D)*	
Craig *et al.*[23]	Australia	88 (M: 62, F: 26)	42.6 (17.8) 18–80	7.3 (6.1) weeks —	Both	54	34	41	47	MINI
Cobo Cuenca *et al.*[22]	Spain	85 (M: 85, F: 0)	35.6 (8.1) 18–65	9.11 (6.4) years —	—	69	16	59	26	HADS
de Carvalho *et al.*[24]	Portugal	65 (M: 48, F: 17)	38.8 (17.1) 18–75	24 (16.7) weeks —	Both	—	—	—	—	SCL-90-R
Geyh *et al.*[25]/ Muller *et al.*[34]	Switzerland	102 (M: 75, F: 27)	56.5 (16.7) —	43.6 (13.5) months	Both	63	38	26	74	HADS
January *et al.*[26,a]	USA	466 (—)	26.9 (3.7) 19–39	12.7 (5.3) years —	Both	—	255	319	—	BAI
Kennedy *et al.*[27,a]	UK	104 (M: 85, F: 19)	— 16–64	— —	Traumatic	58	46	69	35	STAI
Kilic *et al.* [28]	Australia	60 (M: 41, F: 19)	50.8 (17) 19–80	5.7 (7.3) years 1–37	Both	29	22	18	41	DASS-21
Mann *et al.*[29]	US	103 (M: 72, F: 31)	48.7 (14.6) —	90.7 (82.8) months	—	—	—	—	—	HADS
Migliorini *et al.*[30–33]	Australia	443 (M: 345, F: 98)	51.8 (14.4) 18–86	19.2 (13.3) 1–66 years	Both	285	136	181	260	DASS-21
Mitchell *et al.*[1]	Australia	40 (M: 30, F: 10)	49.1 (16.7) 19–82	113.9 (150.3) 1–520 months	Both	26	14	20	9	DASS-21 BSI
Munce *et al.*[8]	Canada	99 (M: 74, F: 25)	50.5 (12.0) —	17.5 (12.3) years—	Traumatic	—	—	—	—	HADS
Nestoros *et al.*[35,a]	Canada	35 (M: 31, F: 4)	—(—) 17–61	—(—) 3–60 months	Traumatic	16	19	—	—	Zung
Nicholson Perry *et al.*[21]	Australia	47 (M: 39, F: 8)	39.8 (15.2) —	— —	—	24	23	21	26	HADS
Rahnama *et al.*[36]	Iran	213 (M: 165, F: 48)	33.7 (9.6) 19–63	4.1 (5.0) .08–33 years	—	—	—	114	99	HADS
Scivoletto *et al.*[37]	Italy	100 (M: 79, F: 21)	36 (14.4) 17–80	6.4 (6.8) years 3 months–28 years	Both	83	17	71	29	STAI
van Lankveld *et al.*[38]	Netherlands	130 —	56.2 (15.8) 18–93	104 (11.8) months 12–558 months	Both	81	47	44	—	HADS
Whalley Hammell *et al.*[39]	UK	15 (M: 15, F: 0)	40 (—) 20–59	—6–62 months	Traumatic	—	—	14	1	Leeds
Woolrich *et al.*[40]	UK	963 (M: 780, F: 183)	48.1 (12.7) 20–97	19.5 (12.3) years 2 – 56	—	623	335	—	—	HADS

Abbreviations: BAI, Beck Anxiety Inventory; BSI, Brief Symptom Inventory (anxiety subscale); DASS-21, Depression Anxiety Stress Scales-21 item; F, female; HADS, Hospital Anxiety and Depression Scale (anxiety subscale); Leeds, Scale for the Self-Assessment of Anxiety and Depression; M, male; MINI, International Neuropsychiatric Interview; SCI, spinal cord injury; SCL-90-R, Symptom Checklist-90 item-Revised; STAI, State Trait Anxiety Inventory; Zung, Self-Rating Scale for Anxiety.
[a]Data analysed for subgroups: January *et al.*[26] anxiety data available for $N = 168$; Kennedy *et al.*[27] observational assessment at 2 years post SCI only (cohort met age criteria > 18); Nestoros *et al.*[35] data for individuals with paraplegia only (cohort met age criteria > 18).
(—) indicates data not provided, missing or incomplete

for Panic Disorder (both lifetime and current), and current Agoraphobia, identified in 2.5% of injured individuals. Craig *et al.*[23] reported an increase in GAD estimates from 3.4% (CI: 0.0, 7.1) on hospital admission to 4.9% (CI: 0.2, 9.6) at the time of discharge.[23] At 1-year post discharge, rates remained relatively stable at 4.2% (CI: 0.0, 8.9).[22] However, the findings cannot be generalised because of the limited data ($N = 40$,[1] $N = 47$[23]) and low associated fail-safe N statistics ($N_{fs} \leqslant 2$).

Self-report. Twenty-seven per cent of individuals with a traumatic or non-traumatic SCI self-reported physical, emotional, cognitive and behavioural symptoms of anxiety (Figure 3). This estimate can be considered robust as it was based on data from 17 studies. Moreover, the associated N_{fs} statistic suggests that at least 136 unpublished studies with non-significant findings would be required to draw this finding into question. Variation in prevalence estimates across the studies (range: 13% to 36%, $I^2 = 60.1\%$) highlights the need for further examination of potential confounding variables.

Measure. Clinically significant 'cases' of self-reported anxiety ranged from 15% (STAI) to 32% (DASS-21): these differences were significant (that is, CIs did not overlap; Figure 4). The most frequently used scale was the Hospital Anxiety and Depression Scale (HADS–A; anxiety subscale), with studies consistently using the proposed cutoff

score of ⩾8. Studies utilising the STAI yielded similar prevalence estimates (13% and 16%, respectively) based on higher cutoff scores for 'caseness': scores of 42 (or 1 s.d. above the mean for norms[37]) and 48,[27] respectively. January *et al.*[26] noted a comparable rate of current anxiety prevalence (29.2%), based on the BAI, and lifetime prevalence (29%) based on self-reported treatment history. Notably, this study utilised a four-factor solution to the BAI (that is, focussing on neurophysiological, subjective, autonomic and panic symptoms) given that many of the physiological components assessed in this measure have potential overlap with SCI complications.[22] The high N_{fs} values add confidence to these results.

Mode of administration. Self-report measures of anxiety were most commonly administered by postal mail, with recent SCI studies utilising a combination of techniques including the completion of questionnaires in a research environment or via an online survey (Figure 5). Average prevalence rates were similar in range, regardless of the method of questionnaire administration (where this was reported). The large N_{fs} values imply that these findings are robust.

Recruitment source. Similar anxiety prevalence rates were noted among hospital admissions during the first 12 months post SCI and those living in the community (see Figure 6). Although the rates were lower when mixed samples were utilised (16%), the overlapping CIs for the individual effect estimates confirm that any observed differences across studies were comparable. The wide CI associated with the hospital group is likely attributed to the small sample sizes utilised by these studies ($N=47$[21] and 65,[24] respectively).

Table 2 Sociodemographic and injury characteristics for individuals with a SCI ($N_{studies}=18$)

Variable	$N_{studies}$	$N_{participants}$	*%*	*Mean*	*s.d.*
Sample size	18	3158	100		
Age (years)	16	3019	96	44.1	8.6
Gender					
Male	16	2026	64		
Female	16	536	17		
Time since injury (in years)	14	2957		8.9	6.4
Nature of Injury					
Traumatic	12	2209	70		
Non-traumatic	11	162	5		
Injury type					
Paraplegia	12	1411	45		
Tetraplegia	13	997	32		
Lesion					
Complete (AIS A)	13	997	32		
Incomplete (AIS B, C, D)	11	647	20		

Abbreviations: $N_{studies}$, number of studies providing data; $N_{participants}$, number of participants in which data were provided; SCI, spinal cord injury.
Note: data missing or incomplete across variables

DISCUSSION

The current study consolidates a body of SCI research that, to date, has been characterised by diverging perspectives on anxiety prevalence. Based on the pooled data from 18 independent studies, prevalence estimates were generated and methodological sources (that is, measure, mode of administration, recruitment source) behind the heterogeneity examined. The findings highlight some important considerations in the psychological management of individuals with an acquired SCI.

Although the limited data preclude any conclusions that can be drawn in relation to diagnostic cases of anxiety post SCI, these data do highlight the reliance on self-report measurements as time and cost-efficient methods of data collection in clinical settings.[10–12] The significant differences in anxiety 'caseness' based on the STAI (which yielded the lowest estimate of state anxiety), HADS and DASS-21 (which produced the highest prevalence estimates) are not fully explained by the time references targeted. Indeed, the HADS, which examines 'current' symptoms, produced an estimate (30%) comparable to the DASS-21 (32%), yet this was distinct from the 15% estimate associated with the STAI, which also examines symptoms 'at this moment'. Notably, accommodations were made for the STAI, with elevated cutoff scores for self-reported 'clinical caseness' utilised in an attempt to improve test specificity and, in turn, achieve reliable estimates of anxiety prevalence.[12,27,37] The STAI is considered a comprehensive 40-item scale that has demonstrated applicability in populations with chronic conditions.[12] Further research is, however, still needed to confirm the utility of proposed cutoff scores. Indeed, the difficulty with applying a cutoff score is that this can potentially lead to misdiagnosis, as those above and below the threshold may not differ significantly.[12]

Regardless of the method of survey administration or assessment timing a comparable number of anxiety 'cases' were identified. This is consistent with longitudinal data that suggest that emotional distress does not necessarily resolve over time, with a subgroup of individuals reporting chronic distress from SCI onset.[15,18,48] This is also contrary to research that suggests that interview settings can increase prevalence estimates, as prompts from the interviewer may help participants recall the trauma associated with their injury.[49,50]

Clinical implications and recommendations for future research

The value of self-report for the identification of psychological conditions should not be undermined.[51] Due to the ease of administration, this form of assessment allows the identification of probable psychological symptoms earlier and more frequently.[51] As such, consistent use of standardised psychological measures to screen for anxiety symptoms in both hospital and community samples with SCI is important, to improve assessment accuracy and, in turn, allow for

Diagnosis	$N_{studies}$	$N_{participants}$	Prevalence	95% CI		N_{fs}	p
				LL	UL		
GAD	2	128	0.05	0.02	0.12	2	0.000
Panic	1	40	0.05	0.01	0.18	1	0.000
Agoraphobia	1	40	0.03	0.00	0.16	0	0.000

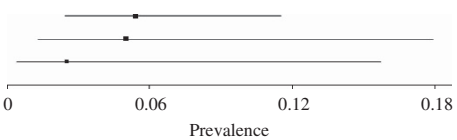

Figure 2 Prevalence of anxiety: MINI. $N_{participants}$, number of participants contributing to effect estimate; N_{fs}, fail-safe *N*.

Lead author	$N_{participants}$	Prevalence	95% CI		N_{fs}	p
			LL	UL		
Nicholson Perry (2009)	47	0.36	0.24	0.51	11	0.061
Cobo Cuenca (2014)	85	0.35	0.26	0.46	11	0.008
Muller (2012), Geyh (2012)	102	0.34	0.26	0.44	10	0.002
Woolrich (2006)	963	0.32	0.29	0.35	10	0.000
Munce (2015)	99	0.32	0.24	0.42	10	0.001
Migliorini (2008, 2009a, 2009b, 2015)	443	0.30	0.26	0.34	9	0.000
Rahnama (2012)	213	0.30	0.24	0.37	9	0.000
Mitchell (2007)	40	0.30	0.18	0.46	9	0.014
January (2014)	168	0.29	0.23	0.37	9	0.000
Kilic (2013)	60	0.27	0.17	0.39	8	0.001
Mann (2013)	103	0.23	0.16	0.32	7	0.000
van Lankveld (2011)	130	0.20	0.14	0.28	6	0.000
Whalley Hammell (1994)	15	0.20	0.07	0.47	6	0.032
Carvalho (1998)	65	0.19	0.11	0.30	5	0.000
Nestoros (1982)	35	0.19	0.06	0.45	5	0.022
Kennedy (2000)	104	0.16	0.10	0.25	4	0.000
Scivoletto (1997)	100	0.13	0.08	0.21	3	0.000
Overall	**2772**	**0.27**	**0.24**	**0.30**	**136**	**0.000**

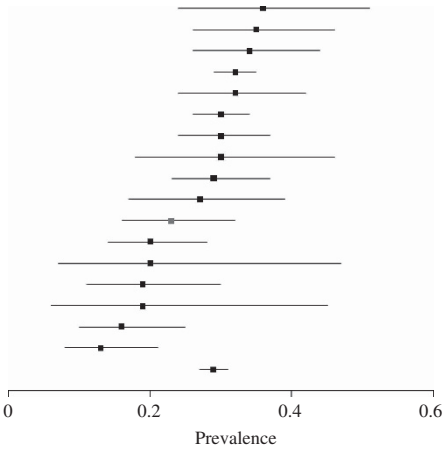

Figure 3 Prevalence of anxiety self-report 'cases': overall.

Measure	$N_{studies}$	$N_{participants}$	Prevalence	95% CI		N_{fs}	p
				LL	UL		
HADS-A	8	1742	0.30	0.27	0.34	72	0.000
DASS-21	3	543	0.32	0.25	0.41	29	0.000
STAI	2	204	0.15	0.11	0.20	8	0.000
BAI	1	168	0.29	0.23	0.37	9	0.000
SCL-90-R	1	65	0.19	0.11	0.30	5	0.000
BSI	1	40	0.18	0.09	0.32	5	0.000
Zung	1	16	0.19	0.06	0.45	5	0.022
Leeds	1	15	0.20	0.07	0.47	6	0.032

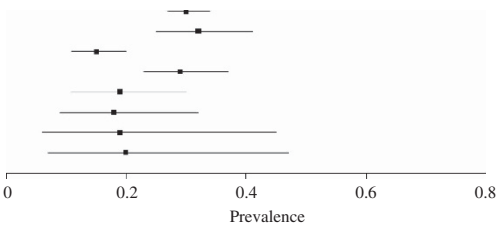

Figure 4 Prevalence of anxiety self-report 'cases': measure.

Mode	$N_{studies}$	$N_{participants}$	Prevalence	95% CI		N_{fs}	p
				LL	UL		
Mail	5	1359	0.26	0.20	0.33	38	0.000
Clinic/Practice	4	428	0.27	0.21	0.34	32	0.000
Combination	3	499	0.29	0.25	0.33	26	0.000
Interview	3	82	0.31	0.26	0.37	28	0.000
Online	1	99	0.32	0.24	0.42	10	0.001
Not reported	1	100	0.13	0.08	0.21	3	0.000

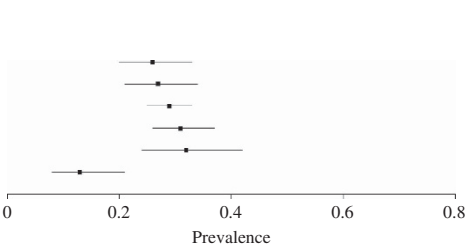

Figure 5 Prevalence of anxiety self-report 'cases': mode of administration.

Recruit	$N_{studies}$	$N_{participants}$	Prevalence	95% CI		N_{fs}	p
				LL	UL		
Community	12	2485	0.29	0.26	0.32	104	0.000
Mixed	3	156	0.16	0.11	0.23	13	0.000
Hospital	2	112	0.27	0.13	0.47	16	0.026

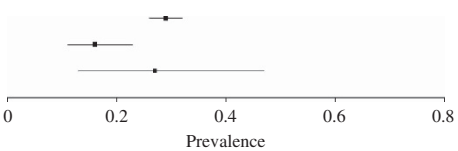

Figure 6 Prevalence of anxiety self-report 'cases': recruitment source.

early intervention to minimise the health-care resources associated with the management of mental health comorbidities.[52]

The use of calibrated self-report tools such as the SCI-Quality of Life Anxiety (SCI-QOL Anxiety[53]) is worthy of consideration. This nine-item tool demonstrates high levels of reliability both as a screening tool for anxiety and an evaluation tool for interventions.[53] Co-occurring symptoms and psychiatric conditions should also be considered in future research. Migliorini *et al.*[30–33] did provide these data and found that 29% of their sample reported clinical symptoms of anxiety, along with depression and general distress. Similarly, Craig *et al* [23] identified GAD comorbidities (e.g. Major Depression, PTSD) among 3–4% of their sample. Measures that identify co-occurring symptoms or conditions can help address this issue. This includes the DSM-5 Cross Cutting Symptom Measures (DSM-CC), which examines overlapping psychiatric domains (for example, depression, anxiety, somatic symptoms, obsessive thoughts and behaviours, personality functioning and so on), allowing for an in-depth assessment of a symptom domain but also a standardised way of tracking

symptom profiles over time.[54] The availability of self and informant versions of the DSM-CC improves assessment accuracy, reliability and objectivity.[54] Although further testing is needed to validate the DSM-5 CC and its application to SCI, this screening tool shows promise as a method of identifying both clinical and sub-threshold psychological symptoms.

Potential biases in the use and administration of self-report measures can be controlled by implementing a number of strategies. This might include the standardisation of test administration within a clinic: allowing a set time to complete the self-report, providing the assessment away from others to reduce any effects of attention bias or effortless responding and, where possible, involving assessors who are not informed of the desired study effects.[50] Respondent burden and, potentially, social desirability biases in survey research can also be minimised by utilising accessible forms of assessment, namely electronic screening of mental health problems via computer and/or internet.[55] For those with a functional disability, this might involve voice recognition or touch screen devices.[56]

The findings also highlight the need for targeted psychological intervention during inpatient rehabilitation. High-quality trials are needed to devise and study treatments for anxiety disorders in people with SCI in a rigorous manner.[57,58] Indeed, the current evidence in relation to cognitive behaviour therapy as a psychological treatment following SCI remains limited, with the available data characterised by small sample sizes and quasi-experimental designs.[57,58]

Methodological limitations

The current study encountered some limitations that need to be considered. In particular, the results need to be interpreted in the context of the primarily small sample sizes recruited from a single SCI unit or regional centre examined in this meta-analysis. Moreover, within-study differences that reflect different trajectories of coping post SCI are not captured by an average effect size estimate per study.[42,44]

Analysis of aetiological factors that may contribute to anxiety post SCI was limited, due to studies not consistently reporting descriptive (that is, sociodemographic, injury) data for their sample in addition to anxiety data for subgroups. Moreover, few studies examined the effects of potential confounds such as current psychotropic or psychological treatment.[6] Similarly, none of the included SCI studies specifically asked participants about the genesis of their anxiety symptoms, to rule out the effects of premorbid or prior anxiety.

In addition, the MINI version 5 for DSM-IV utilised by the included studies relies on now outdated conceptualisations of anxiety. The symptom model incorporated by the DSM-5 may enable more accurate diagnosis of anxiety in disability research compared with earlier DSM criteria.[12] The Structured Clinical Interview (SCID), absent among the identified studies, has been updated to incorporate a DSM-5 framework.[59] However, it is not clear whether, and how, available interview schedules (for example, MINI, SCID) influence anxiety prevalence estimates. There is some suggestion that estimates of GAD among traumatic injury groups can vary from 2 to 28%, depending on the interview schedule.[60] This may well be explained by procedural differences, including lay- vs clinician-administered schedules in addition to an emphasis on current vs lifetime diagnosis.[61] Similarly, there are differences in the criteria for anxiety disorders across the two major classification systems, the DSM[9] and International Classification of Diseases (ICD)[62] resulting in differing prevalence estimates.[63,64] Further empirical investigation on the comparability of these two systems is, however, needed.[64]

Finally, the data in this meta-analysis were largely reliant on cross-sectional research. Longitudinal SCI research is important to determine the incidence and the development of mental disorders over time. Notably, the studies that utilised repeated assessments identified a consistent pattern of results, with a high number of individuals meeting the criteria for anxiety caseness from 12 months to 10 years post injury.[23,26,27]

CONCLUSION

The findings of this quantitative review confirm that a significant minority of individuals with SCI experience disorders or symptoms of anxiety that persist over time. The data highlight the importance of routine psychological assessment throughout the spinal rehabilitation process in addition to the need for consistency in the selection and administration of psychological measurement across studies. Further research on the reliability and validity of individual measures of psychological function following SCI, including the appropriateness of different cut-off scores for caseness, will help to establish guidelines for the interpretation of anxiety outcomes in this specialised population. By addressing these issues, the clinical utility of this research can be enhanced.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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APPENDIX A
Search strategies for electronic databases

PsycINFO

Anxiety disorder	*Spinal cord injury*
(anxiety disorders.sh OR anxiety disorder*.ti OR anxiety disorder*.ab OR anxious.ti OR anxious.ab OR generali#ed anxiety.ti OR generali#ed anxiety.ab OR anxiety neurosis.sh OR anxiety neurosis.ti OR anxiety neurosis.ab OR phobias.sh OR phobia*.ti OR phobia*.ab OR panic disorder.sh OR panic disorder*.ti OR panic disorder*.ab OR mental disorders.sh OR mental disorder*.ti OR mental disorder*.ab OR mental disease*.ti OR mental	(spinal cord injuries.sh OR spinal cord injur*.ti OR spinal cord injur*.ab OR spine injur*.ti OR spine injur*.ab OR spinal injur*.ti OR spinal injur*.ab OR spinal cord trauma*.ti OR spinal cord trauma*.ab OR spinal fracture*.ti OR spinal fracture*.ab OR parapleg*.ti OR

(Continued)

Anxiety disorder	*Spinal cord injury*
disease*.ab OR mental health.ti OR mental health.ab OR mental illness*.ti OR mental illness*.ab OR psychological distress.ti OR psychological distress.ab OR psychopathology.ti OR psychopathology.ab OR psychosocial outcome*.ti OR psychosocial outcome*.ab OR psychological outcome*.ti OR psychological outcome*.ab OR psychological adjustment.ti OR psychological adjustment.ab)	parapleg*.ab OR quadripleg*.ti OR quadripleg*.ab OR tetrapleg*.ti OR tetrapleg*.ab)

Note: applied 'date' (1970–2015) and 'language' filters (English).

PubMed

Anxiety disorder	*Spinal cord injury*
(anxiety[mh] OR anxiety disorder [mh] OR anxious [tiab] OR generalised anxiety [tiab] OR anxiety neurosis [tiab] OR phobia* [tiab] OR panic disorder* [tiab] OR mental disorder*[tiab] OR mental disease*[tiab] OR mental health[tiab] OR mental illness*[tiab] OR psychological distress[tiab] OR psychopathology[tiab] OR psychosocial outcome*[tiab] OR psychological outcome*[tiab] OR psychological adjustment[tiab])	(spinal cord injuries[mh] OR spinal injuries[mh] OR spinal cord injur*[tiab] OR spine injur*[tiab] OR spinal injur* [tiab] OR spinal cord trauma*[tiab] OR spinal fracture*[tiab] OR parapleg*[tiab] OR quadripleg*[tiab] OR tetrapleg*[tiab])

Note: applied 'date' (1970–2015) and 'language' filters (English).

Embase

Anxiety disorder	*Spinal cord injury*
('anxiety':de,ab,ti OR 'anxiety disorder':de,ab,ti OR 'anxious':ab,ti OR 'generalised anxiety disorder':ab,ti OR 'anxiety neurosis':de,ab,ti OR 'phobia':ab,ti OR 'phobias':ab,ti OR 'panic disorder':ab,ti OR 'panic disorders':ab,ti OR 'mental disorder':ab,ti OR 'mental disorders':ab,ti OR 'mental health':ab,ti OR 'mental illness':ab,ti OR 'mental illnesses':ab,ti OR 'psychological distress':ab,ti OR 'psychopathology':ab,ti OR 'psychosocial outcome':ab,ti OR 'psychosocial outcomes':ab,ti OR 'psychological outcome':ab,ti OR 'psychological outcomes':ab,ti OR 'psychological adjustment':ab,ti)	('spinal cord injury':de,ab,ti OR 'spine injury':de,ab,ti OR 'spinal cord injuries':ab,ti OR 'spinal cord injured':ab,ti OR 'spine injuries':ab,ti OR 'spine injured':ab,ti OR 'spinal injury':ab,ti OR 'spinal injuries':ab,ti OR 'spinal injured':ab,ti OR 'spinal cord trauma':ab,ti OR 'spinal cord traumas':ab,ti OR 'spinal fracture':ab,ti OR 'spinal fractures':ab,ti OR 'paraplegia':ab,ti OR 'paraplegic':ab,ti OR 'paraplegics':ab,ti OR 'quadriplegia':ab,ti OR 'quadriplegic':ab,ti OR 'quadriplegics':ab,ti OR 'tetraplegia':ab,ti OR 'tetraplegic':ab,ti OR 'tetraplegics':ab,ti)

Note: applied 'date' (1970–2015), 'species' (Human), 'language' (English) and 'source' (Embase NOT Medline) filters.

APPENDIX B
Data extraction sheet

Article Title:
Author:
Year:
Country:

Sample characteristics

Age at assessment (>18 years)

☐ Estimated by available data (mean age minus 1 SD ≥ 18 years)

☐ Specified overall
Mean (SD):
Median :
Range :

☐ Specified via sub-groups (so can calculate overall)

Sample size

SCI group (N =)
Comparison group (N =)
Specify comparison group (healthy vs other disability): _____
_____

Sample recruitment

☐ Not specified
☐ Hospital Inpatient
☐ Database
☐ Rehab Clinic / Treatment Centre
☐ Medical Centre / GP
☐ (Hospital?) Outpatient
☐ Other (specify): _____
_____

Gender

☐ Not specified
☐ Specified:
_____ No. Males (%)
_____ No. Females (%)

Education

☐ Not specified
☐ Defined as: _____
_____

☐ Specified:
Mean years (SD):
Median:
Range:

Relationship status

☐ Not specified
☐ Defined as: _____
_____

Employment status

☐ Not specified
☐ Defined as: _____
_____

SCI cause

☐ traumatic SCI only (N =)
☐ non-traumatic SCI only (N =)
☐ both traumatic (N =) and non-traumatic SCI (N =)

SCI type

☐ Not specified
☐Specified:
Paraplegia (N =)
Quadriplegia (N =)

SCI severity (Frankel or AIS grading)

☐ Not specified
☐ Specified: _____
A (N =) complete injury
B (N =) incomplete injury
C (N =) incomplete injury
D (N =) incomplete injury
E (N =) normal

Time post-SCI

☐ Not specified:
☐ Specified:
Mean years (SD):
Median:
Range:

Effect size data

Outcome measure: _____
Method of administration: ☐ self-administration ☐ clinical interview ☐ other: _____
Cut-off score (if applicable): _____
Prevalence estimate:

Other data (eg. medications prescribed, pre-morbid psychiatry history, exclusion criteria, study design etc):