SCIRE

SPINAL CORD INJURY REHABILITATION EVIDENCE

Mental Health after a Spinal Cord Injury

Swati Mehta
Steve Orenczuk
Daymon Blackport
Robert Teasell

icord

Rick Hansen Institute
Institut Rick Hansen

Ontario Neurotrauma Foundation
Fondation ontarienne de neurotraumatologie

LAWSON HEALTH RESEARCH INSTITUTE
Aging, Rehabilitation & Geriatric Care

Western

UBC

G.F. Strong Rehab Centre
A part of the Vancouver Coastal Health Authority

St Joseph's Health Care London

Key Points

Individual based CBT is effective in reducing symptoms of depression post SCI; however, the results may not be maintained at follow-up.

Cognitive behavioural interventions provided in a group setting appear helpful in reducing post-SCI depression among those with elevated symptoms of depression.

CBT interventions aimed at both caregivers and care receivers may be effective in reducing symptoms of depression post SCI.

Telerehabilitation or online CBT improves symptoms of depression post SCI.

Online chronic pain-based mindfulness programs help reduce symptoms of depression among persons with SCI.

Peer telephone counselling may not be effective in reducing symptoms of depression post SCI.

Combining pharmacotherapy with CBT or supportive psychotherapy results in improved mood post SCI.

Venlafazine improves depressive symptoms post SCI.

Small group exercise programs improve depressive symptoms in persons with SCI.

Yoga improves depressive symptoms.

Body weight supported treadmill training may not improve symptoms of depression post SCI.

Parastep FNS ambulation training may improve symptoms of depression.

Increased sport and recreational activities may improve depressive symptoms.

Massage may be effective in reducing symptoms of depression.

Repetitive transmagnetic stimulation may improve symptoms of depression post SCI.

Hyperbaric oxygen may improve depressive symptoms.

Education may not improve depressive symptoms post SCI.

Individual based CBT is effective in reducing symptoms of anxiety post SCI; however the results may not be maintained at follow-up.

Cognitive behavioural interventions provided in a group setting appear helpful in reducing post-SCI anxiety among those with elevated symptoms.

Telerehabilitation or online CBT improves symptoms of anxiety post SCI.
Physical activity may improve anxiety post SCI.

Cranial electrotherapy stimulation may not be effective in reducing anxiety symptoms post SCI.

Table of Contents

Mental Health after a Spinal Cord Injury

1.0 Executive Summary

Depression is one of the most common mental health concerns after spinal cord injury (SCI). As many as 40% of people experience depression during rehabilitation and around 1 in 5 people experience depression a year after the injury. Depression can be a serious problem after SCI. It can interfere with recovery and rehabilitation and is related to longer hospital stays, higher levels of pain, and lower quality of life after injury. Additionally, physical and lifestyle changes after SCI can lead to cognitive and behavioural symptoms of anxiety including excessive worrying, catastrophic thinking, and perceived lack of control. Chronic anxiety has been significantly correlated with other secondary conditions including depression and chronic pain. Appropriate management of these secondary conditions, through a multidisciplinary approach, is imperative as they have been shown to contribute to slower recovery, increased negative outcomes, and greater rates of rehospitalization and health care utilization.

What are the management options for mental health post SCI?
Currently, cognitive behaviour therapy has the strongest evidence for managing mental health concerns post SCI. Pharmacological approaches such as venlafaxine may improve mood among those with noiciceptive pain. Physical interventions such as small group exercise programs and increase in recreational activities may improve symptoms of depression and anxiety. There is limited evidence for the effectiveness of repetitive transmagnetic stimulation in improving symptoms of depression.

Gaps in the Evidence
Though pharmacological treatment is commonly prescribed for managing depression and anxiety symptoms post SCI, there is a limited evidence supporting its use. Since individuals with SCI may be on several medications to manage their secondary complications, evaluation of safety and efficacy of these among the population is warranted. Additionally, studies evaluating the combination of non-pharmacological, behavioural, and pharmacological approaches should be evaluated.

2.0 Introduction

Psychological adjustment to catastrophic injuries and illnesses is a topic of much interest for practitioners providing clinical rehabilitation services. Depression and anxiety symptoms are associated with negative outcomes among individuals with SCI including lower functional independence, more secondary complications, and less community and social integration (Fann et al., 2011; Paul Kennedy & Rogers, 2000). This chapter attempts to summarize evidence garnered from SCI research that has investigated the management of post-SCI mental health potentially affecting successful adjustment to SCI. Though limited, these findings can assist in developing a foundation for evidence-based practice, and hopefully lead to improved and more consistent care. It should be emphasized, however, that evidence-based practice constitutes more than the routine use of treatments supported by the best research evidence available. Such practice also necessitates that the practitioner employ his or her clinical judgment in determining the applicability of such research conclusions to the treatment provided each patient.

3.0 Depression

Concerns regarding *"depression"* are commonly reported by SCI survivors, staff, or their families. Elliott and Umlauf (1995) report that depression is the most frequently researched psychological issue in individuals who have sustained a SCI. Given the losses and innumerable adjustments necessitated following a SCI, an individual will likely encounter repeated strains upon available coping resources. The term *"depressed mood"* refers to a state of dysphoria that occurs routinely and is considered a normal process (Elliott & Frank, 1996). In contrast, a diagnosable "depressive syndrome" refers to a constellation of observable affective, cognitive and neuro-vegetative symptoms of sufficient frequency and severity to negatively impact the functioning of an individual. Identifying clinical depression is often more difficult than might be anticipated. Rehabilitation staff has been shown to overestimate the incidence of depression in inpatient populations (Cushman & Dijkers, 1990) while underestimating individuals' reported coping ability and mental health (Siösteen, Kreuter, Lampic, & Persson, 2005).

3.1 Prevalence of Depression Post-SCI

A recent meta-analysis reported rates of probably depression between 19 -26% with average prevelance of 22% (Williams & Murray, 2015). Bombardier and colleagues (2004) surveyed 849 SCI outpatients at 1-year post injury and found 11.4% met criteria for major depressive disorder. Krause et al., (2000) suggest a 42% overall rate of depression with a 21% probable rate of major depression – indicative of a 4-fold increase of depressive disorders among individuals with SCI when compared with samples of non-disabled individuals. Of note, many studies do not include information regarding use of antidepressants, other medications, or psychotherapeutic interventions in their reports. Accordingly, observed rates of depressive symptoms may potentially be a reflection of multiple additional factors and the *"net effect of all treatments"* (Krause, Bombardier, & Carter, 2008). As health problems can produce pain, fatigue, sleep disturbances, physical sensations and digestive troubles, the overlap of somatic symptoms can pose diagnostic challenges. In general, despite the potential for an increase in "false positives," reports of somatic symptoms merit clinician review given their strong association with affective or more general symptoms of depression (Krause et al., 2008; Richardson & Richards, 2008).

3.2 Interventions for Treatment of Depression following SCI

Difficulties inherent in conducting intervention studies are numerous (King & Kennedy, 1999). The SCI population can be heterogeneous. Most sites do not have access to a large number of individuals and obtaining treatment and appropriate control groups requires the participation of multiple sites. Also, ethical concerns over providing the best possible care to all individuals with SCI are obvious, so that withholding aspects of treatment in order to establish control conditions is no longer acceptable (e.g. (Kahan, Mitchell, Kemp, & Adkins, 2006). To date, research strategies have frequently used self-report screening measures (e.g. Beck Depression Inventory, Zung Depression Inventory, Patient Health Questionnaire-9, Center for Epidemiological Studies – Depression Scale; Older Adult Health and Mood Questionnaire; Depression, Anxiety and Distress Scale), and while they offer many benefits (e.g. low cost, quick, easy to complete), they require further evaluation to support a diagnosis of depression.

Table 1. Systematic Reviews and Meta-Analysis: All Treatments

Authors Year Country Date of Studies Included AMSTAR Score Total Sample Size	Method	Conclusions

Dorstyn et al. (2011) Australia Review of published articles between January 1980 and April 2010 AMSTAR=10 N=10	**Method:** Comprehensive literature search of English RCT, Cohort studies, case series, and review articles of traumatic SCI in adult age group (18+yr). **Databases:** MEDLINE, Psych Info, Cochrane Library, Meditext, CINAHL, Scopus. **Level of evidence:** Effect sizes were provided **Questions/measures/hypothesis:** Examine the effectiveness of cognitive behavioural therapy (CBT) in improving psychological outcomes post SCI.	1. Effect sizes for assertiveness, coping, self-efficacy, depression, acceptance, anxiety, locus of control and self-esteem ranged from very small to large post CBT treatment. 2. Moderate to large effect sizes were seen in quality of life post CBT treatment.
Mehta et al., (2011) Canada Review of published articles between January 1990 to October 2010 AMSTAR=10 N=9	**Method:** Comprehensive literature search of English RCT, Cohort studies, case series, and review articles of traumatic SCI in adult age group (18+yr). A meta-analysis was conducted. **Databases:** MEDLINE, Psych Info, CINAHL, EMBASE. **Level of evidence:** *Moderate quality:* Downgraded high-quality studies, non-randomized trials, prospective cohort studies; *Low quality:* Retrospective observational, retrospective cohort and case-control studies; *Very low quality:* Case series, case reports, reviews and others. Effect sizes were provided **Questions/measures/hypothesis:** Examine the effectiveness of Cognitive Behavioural Therapy (CBT) in improving psychological outcomes post SCI.	1. One study demonstrated large effect sizes in the improvement of depression symptoms post CBT treatment; 4 studies demonstrated moderate effects; 4 studies demonstrated small effects. These effects were shown to last for up to 2yr in individuals diagnosed with major depressive disorder prior to the intervention. 2. Moderate effects sizes were seen on anxiety symptoms were seen in 2 studies post CBT treatment; 2 studies reported small effect sizes and 1 study reported no effect of CBT on anxiety symptoms post SCI. 3. CBT treatment resulted in small effects on self-esteem, coping and adjustment post SCI.
Elliot & Kennedy (2004) USA Time line not stated AMSTAR=7 N=9	**Method:** Comprehensive literature search of English RCT, Cohort studies, case series, and review articles of traumatic SCI in adult age group (18 + years). **Databases:** MEDLINE, PsycInfo. **Level of evidence:** *Moderate quality:* Downgraded high-quality studies, non-randomized trials, prospective cohort studies; *Low quality:* Retrospective observational, retrospective cohort and case-control studies; *Very low quality:* Case series, case reports, reviews and others. **Questions/measures/hypothesis:** Examine the effectiveness of depression treatment post SCI.	1. There was moderate level evidence from 3 studies for psychological interventions in improving depressive symptoms post SCI. 2. There was high level evidence from 1 study and low level evidence from 4 studies for the use of antidepressants for depressive symptoms post SCI. 4. Functional electrical stimulation (FES) was supported by 1 moderate level study.

Three studies examined the effects of interventions aimed towards psychological impairment post SCI. In a systematic review, Elliot and Kennedy (2004) evaluated the effectiveness of depression treatments post SCI through a systematic narrative review of the results. The study found psychological interventions, pharmacological therapy and functional electric stimulation had moderate to high level of evidence in improving depressive symptoms post SCI. Dorstyn et

al., (2011) and Mehta et al., (2011) examined the effectiveness of Cognitive Behavioural Therapy (CBT) on a range of psychosocial issues faced by individuals with SCI. Both studies found small to large effects of CBT on depressive and anxiety symptoms. Dorstyn et al., (2011) also found moderate to large effect sizes in the improvement of quality of life post CBT treatment in individuals with SCI.

3.3 Psychological Interventions

3.3.1 Cognitive Behavioural Therapy

In the SCI population, the application of CBT approaches to aid in the management of anxiety and depression is described as a prudent choice given its demonstrated effectiveness in a wide range of disorders (Craig, Hancock, Dickson, & Chang, 1997). CBT strategies can include addressing "irrational" or negative thoughts, increasing opportunities for participating in rewarding activities, and instruction in relaxation, among others. Within this context, issues of assertiveness, social skills and discussions of sexuality have also at times been included to address the unique concerns of individuals with SCI. Employing a group setting to provide CBT can also be a cost-effective opportunity for peer support, practice of social skills and the opportunity for gaining additional viewpoints. Several authors have described the effects of group CBT interventions for individuals following SCI to reduce psychological distress and/or provide *"immunization"* against future difficulties.

Table 2. Cognitive Behavioural Therapy Group Interventions

Author Year Country Research Design PEDro Score Total Sample Size	Methods	Outcome
Burke et al., (2019) Ireland RCT PEDro=8 $N_{Initial}$=69 N_{Final}=57	**Population:** Mean age=52±13 yr; Gender: males=52, females=17; Time since injury=16±12.1 yr; Level of injury: C=17, T=30; L=14, Not reported=8; Severity of injury: AIS A=4, B=2, C=3, D=4, Not reported=55. **Intervention:** Participants were randomly assigned to either a control group where they went about their normal routine and the intervention group received an online six module cognitive behavioural therapy pain management program once per wk for 12 wk. **Outcome Measures:** World Health Organization Quality of Life Bref (WHOQOL-Bref), International Spinal Cord injury Quality of Life Basic Data Set (ISCIQOLBDS), International Spinal Cord Injury Pain Basic Data Set (ISCIPBDS), Douleur Neuropathique en 4 Questions (DN4), Chronic Pain Acceptance Questionnaire 8 (CPAQ8), Brief Pain Inventory (BPI), Hospital Anxiety and Depression Scale (HADS) and Pittsburgh Sleep Quality Index (PSQI).	1. Moderate linear relationship found between the number of modules in which the users engaged in 80% or more of the content and reductions in overall pain intensity ((NRS) (p=0.05), the ISCIPBDS pain interference score (p=0.08), the LSF domain (p=0.039), the BPI interface scale (p=0.10) and the depression subscale of the HADS (p=0.10). 2. At 3-mo follow-up a moderate linear relationship between module engagement and improvements in sleep quality (p=0.06), the AMS subcategory of the ISCIPBDS (p=0.09) and both the depression (p=0.03) and anxiety (p=0.05) subscales of the HADS.
Coker et al., (2019) USA RCT PEDro=8	**Population:** Control Group (n=40): Mean age=52±15.3 yr; Gender: males=32, females=8; Time since injury=81.5 mo; Level of injury: complete=16,	1. Non-significantly greater increase in MSES for the treatment group compared to the control group from baseline to 6-wk and neither group

Author Year Country Research Design PEDro Score Total Sample Size	Methods	Outcome
N=81	incomplete=24; Severity of injury: AIS A=16, B=3, C=8, D=13. Intervention Group (n=41): Mean age=48±12.8; Gender: males=34, females=7; Time since injury=95 mo; Level of injury: complete=19, incomplete=22; Severity of injury: AIS A=19, B=2, C=7, D=13. **Intervention:** Participants were randomized to either a control group in which they continued their normal rehabilitation or an intervention group in which they took part in an interactive cognitive behaviour therapy based learning program for one session per wk, 2 hrs per session for 6 wk with assessments at baseline, post intervention and at 8-wk intervals post intervention. **Outcome Measures:** Moorong Self-Efficacy Scale (MSES), Generalized Self-Efficacy Scale (GSES), Diener Satisfaction with Life Scale (SWLS), Participation Assessment with Recombined Tools – Objective (PART-O), Patient Health Questionnaire – 9 (PHQ-9), and General Anxiety Disorder 7-Item (GAD-7).	showed significant difference from baseline to the 30-wk follow-up (p=0.15). 2. The treatment group showed significant improvements for the GSES, PHQ-9 and GAD-7 from baseline to 6-wk whereas the control group did not. 3. Neither group showed significant changes in SWLS or PART-O from baseline to 6-wk. 4. Despite the significant differences for the treatment group from baseline to 6-wk or from baseline to 30-wk follow-up, there are no significant differences in results between treatment and control.
Migliorini et al., (2016) Australia RCT PEDro=8 $N_{Initial}$=59 N_{Final}=48	**Population:** Intervention group (n=34): Mean age=47.5±12.2 yr; Gender: males=25, females=9; Time since injury=11.4±11.9 yr; Level of injury: complete paraplegia=5, incomplete paraplegia=8, complete tetraplegia=1, incomplete tetraplegia=18, unknown=2. Waitlist control group (n=25): Mean age=52.8±12.9 yr; Gender: males=17, females=8; Time since injury=19.8±14.0 yr; Level of injury: compete paraplegia=7, incomplete paraplegia=13, complete tetraplegia=2, incomplete tetraplegia=2, unknown=1. **Intervention:** Participants were randomized to either an Electronic Personal Administration of Cognitive Therapy (ePACT) group in which the participants completed 10-module skills or a Waitlist Control group with assessments at baseline, 3 mo follow-up and 6 mo follow-up. **Outcome Measures:** Depression, anxiety and stress scale-short (DASS21), personal well-being index, helplessness subscale and score above normative threshold of the depression, anxiety and stress scale-short form (DASS21).	1. 71 individuals accepted the option to try the ePACT, but 12 did not complete the intake process and those that completed the intake process and those that did not only differed significantly with regards to stress scores (p=0.05). 2. No significant differences between groups at baseline besides for time since injury (p=0.02) and level of injury distribution. 3. Dropouts from the intervention group did not differ significantly from those that did not drop out in any outcome measure. 4. At post-intervention, the ePACT group showed a significant reduction in depression, anxiety and stress and satisfaction with life significantly improved (p<0.05 for all) while the waitlist control group improved significantly with a reduction in depression (p=0.01). 5. Significant reductions in depression, anxiety and stress were maintained from post-intervention to 6 mo follow-up, and even reduced even more, albeit insignificantly.

Author Year Country Research Design PEDro Score Total Sample Size	Methods	Outcome
Dorstyn et al., (2012) Australia RCT PEDro=6 N=40	**Population:** Age=53.5yr; Gender: males=69%, females=31%; Level of injury: paraplegia=24, tetraplegia=16. **Intervention:** Individuals with SCI were randomly assigned to receive telecounselling or standard inpatient care. Individuals in the treatment group received 12 weeks of biweekly phone motivational interviewing intervention for 20 mins. **Outcome Measures:** Depression Anxiety Stress Scale-21 (DASS-21)	1. Small improvement in depression (d=0.32) were seen among individuals that received telecounselling compared to standard treatment group post intervention. 2. 4 of the 8 individuals in the treatment group that reported mild, moderate or extremely severe levels of depression and/or anxiety reported no symptoms postintervention; with maintenance up to follow-up. 3. Individuals in the standard care group reported increase in clinically significant symptoms of depression over time.
Heutink et al., (2012) Netherlands RCT PEDro=6 $N_{Initial}$=61 N_{Final}=59	**Population:** Mean age=58.8 yr; Gender: males=39, females=22; Duration of pain=5.4 yr; Type of pain=neuropathic. **Intervention:** Individuals with SCI with chronic neuropathic pain were randomly assigned to receive interdisciplinary pain management which included Cognitive Behavioural Therapy (CBT) and education or wait list control group. The intervention consisted of 10 sessions over 10 week period with a comeback session 3 weeks after the 10th session. **Outcome Measures:** Chronic Pain Grade Questionnaire; Hospital Anxiety and Depression Scale (HADS).	1. No significant difference in HADS depression was seen between the two groups or over time.
Duchnick et al., (2009) USA RCT PEDro=4 N=40	**Population:** Coping effectiveness training (CET): Mean age=50.8yr; Gender: males=95%; Level of injury: tetraplegia=40%; Severity of injury: AIS A=30%; B=30%; C=5%; D=35%; Supportive group therapy (SGT): Mean age=54.6yr; Gender: males=100%; Level of injury: tetraplegia=70%; Severity of injury: AIS A=20%, B=20%, C=20%, D=40%. Depression status=mild (no severe psychiatric condition score based on Mini-Mental State Examination). **Intervention:** Participants were randomly allocated into either the CET group or the SGT group. Each inpatient group met 1x/wk for 60 min. The CET group focused on: stress and appraisal, problem solving, communication skills, behavioral strategies, cognitive strategies and social support/assertiveness. SGT group emphasized the sharing of experiences and information related to SCI, emotional and cognitive reactions, and support and education from peers and psychologist. **Outcome Measures:** Center for Epidemiologic Studies Depression Scale	1. No baseline differences were found. 2. Mood change was not affected by treatment condition. 1. Significant decrease in depression (CES-D) was seen at discharge ($p<0.05$). However, depression ($p<0.05$) increased significantly between discharge and follow-up (3 mo).

Author Year Country Research Design PEDro Score Total Sample Size	Methods	Outcome
	(CES-D), State Trait Anxiety Inventory (STAI).	
Schulz et al., (2009) USA RCT PEDro=6 N=346	**Population:** Mean age=53 yr; Mean time since injury=8 yr. **Intervention:** Participants with SCI and their caregivers were randomly placed into 3 groups: caregiver only intervention; dual target intervention; information only control condition. Interventions were provided through computer telephone over a 6 mo period. The intervention involved knowledge and cognitive behavioural skills for coping with SCI. **Outcome Measures:** Center for Epidemiologic Studies Depression Scale (CES-D), health symptoms, self-care problems, social integration.	2. Significant improvement in individuals with SCI's CES-D and health symptoms were seen in the dual treatment group compared to the caregiver only group (p=0.014 versus p=0.031). 2. Clinically significant improvement was also seen in caregivers in the dual target group compared to the caregiver only and control group on CES-D, burden, health symptoms.
Li et al., (2019) China Pre-Post N=20	**Population:** Intervention group (n=9): Mean age=41.7±8.1 yr; Gender: males=9, females=0; Time since injury=8.1±4.1 mo; Level of injury: paraplegia=5, tetraplegia=4; Severity of injury: complete=5, incomplete=4. Comparison group (n=11): Mean age=43.0±15.7 yr; Gender: males=11, females=0; Time since injury=8.2±4.1 mo; Level of injury: paraplegia=7, tetraplegia=4; Severity of injury: complete=5, incomplete=6. **Intervention:** Participants were assigned to either an 8-wk coping oriented supportive program (COSP) or a comparison group going about their usual business. **Outcome Measures:** Feasibility, acceptability, brief coping orientations to problems experienced inventory, experienced inventory, Moorong self-efficacy scale, hospital anxiety and depression scale (HADS), quality of life enjoyment and satisfaction questionnaire – short form and six-item social support questionnaire.	1. Recruitment rate of this study was 88% and the retention rate was 100%, but 2 participants in the COSP group did not attend the minimum number of sessions necessary for analysis. 2. Participants reported that the meeting times and the length of each meeting were very appropriate, while one participant mentioned meeting more frequently on a weekly basis. 3. Encouragement and support from peers were reported as motivation enhancers and enjoyed the communication during the meetings. 4. Significantly higher self-efficacy scores in the COSP group compared to the comparison group (p=0.048). 5. Statistically significant effects of the COSP on participant's life enjoyment and satisfaction (p=0.005) and satisfaction of social support (p=0.022). 6. Statistically significant improvements in self-efficacy (p=0.008), depression (p=0.007) and satisfaction with medicine (p=0.046) for the COSP group, but not the comparison group.
Dear et al.,(2018) Australia Pre-Post N=68	**Population:** Mean age=48.0±13.0 yr; Gender: males=34, females=34; Time since injury=8.0±10.0 yr; Severity of injury: complete=15, incomplete=44, unsure=9. **Intervention:** Participants completed five online lessons and homework tasks for pain management with weekly support from a clinical psychologist. **Outcome Measures:** Pain disability index (PDI), patient health questionnaire 9-item (PHQ-9), generalized anxiety	1. Significant overall effect observed for pain-related disability (p<0.001), anxiety (p<0.001) and depression (p<0.001), as well as improvements in all three from baseline to post-treatment (p<0.001) and even further improvements at 3-mo follow-up (p<0.015). 2. Significant overall time effect observed for pain self-efficacy (p<0.001), pain catastrophizing

Author Year Country Research Design PEDro Score Total Sample Size	Methods	Outcome
	disorder scale 7-item), Wisconsin brief pain questionnaire (WBPQ), pain self-efficacy questionnaire (PSEQ), pain catastrophizing scale (PCS), satisfaction with life scale (SWLS).	(p<0.001) and life satisfaction (p<0.001). 7. Significant improvements from baseline to post-treatment for pain catastrophizing and life satisfaction (p<0.001) with life satisfaction improving from post-treatment to follow-up (p=0.006) but not pain catastrophizing (p=0.062).
Verwer et al., (2016) Netherlands Pre-Post $N_{Initial}$=14 N_{Final}=7	**Population:** Mean age=44.7 yr; Gender: males=11, females=3; Time since injury=15 mo; Level of injury: paraplegia=10, tetraplegia/unknown=4; Severity of injury: complete=6, incomplete=8. **Intervention:** Participants engaged in an online self-help program called Psyfit in which they were asked to complete 2 of 6 modules with 4 wk given to complete each module and assesments taken pre-intervention, post-intervention and at 3-mo follow-up. **Outcome Measures:** Adherence, satisfaction, mental health inventory-5 (MHI-5), center for epidemiological studies depression scale (CES-D), and the Warwick-Edinburgh mental well-being scale.	1. 75% of the participants completed the first module and 39% completed the second, 11 participants finished 50% or more of the first module and 7 completed the entire first module and started with the second module and these were considered the study completers. 2. Five of the seven completers reported that the program was good and they would recommend it to others. 3. The main criticism was that the program was not specified to SCI participants enough, and the other was that the program modules were too long and rigid, making them difficult to want to complete. 3. Study completers showed significant improvements in the MHI-5 scores from pre- to post-intervention (p<0.05) and all scores decreased significantly between post-intervention and 3-mo follow-up (p<0.05), resulting in no significant difference from pre-intervention to 3-mo follow-up (p>0.05).
Heutink et al., (2014) Netherlands Follow-Up N=29	**Population:** Mean age=56.5yr; Gender: males=21, females=8; Level of injury: paraplegia=18, quadriplegia=11; Severity of injury: incomplete=14, complete=15; Mean time post injury=5.4yr; Depression status=symptoms. **Intervention:** Participants who received treatment in Heutink et al.,(2012) were assessed at 6, 9, and 12mo follow-up. **Outcome Measures:** Hospital Anxiety & Depression Scale (HADS).	1. HADS-depression scores did not change over time.
Dorstyn et al., 2011 Australia PCT N=24	**Population:** Treatment: Mean age=53.2yr; Gender: males=9, females=2; Level of injury: paraplegia=6, quadriplegia=5; Severity of injury: complete=8, incomplete=3; Control: Mean age=44.5yr; Gender: males=11, females=2; Level of injury: paraplegia=8, quadriplegia=5; Severity of injury: complete=11, incomplete=2;	1. Mood had no effect on functional independence measure outcomes at admission or discharge. 2. Total DASS-21 scores did not change significantly over time in the treatment group however, depression subscores varied significantly. 3. Mean depression subscores decreased significantly post

Author Year Country Research Design PEDro Score Total Sample Size	Methods	Outcome
	Intervention: Individuals were assessed using the Depression Anxiety Stress Scale-21 (DASS-21). Those with subclinical DASS-21 scores were placed in the control group. Those with moderate to severe scores were offered individual Cognitive Behavioural Therapy (CBT) treatment for a range of 7 to 22 sessions for 30-60mins each. These individuals were also prescribed low dose amitriptyline as well as 5 control participants for neuropathic pain. **Outcome Measures:** Depression Anxiety Stress Scale-21 (DASS-21)	interventions; however increased significantly at 3 mo follow-up. 3. At 3 mo follow-up, 78% of individuals in the treatment group met clinical levels of caseness on the DASS-21; only 1 individual in the control group met these criteria.
Migliorini et al., (2011) Australia Pre-Post N=3	**Population:** Age range=41-65yr; males=2, females=1; Severity of injury: incomplete=2, complete=1 **Intervention:** Participants were offered a computer based Cognitive Behavioural Therapy (CBT) intervention involving 10 modules. **Outcome Measures:** Depression Anxiety Stress Scale-21 (DASS-21), PWI, SCL EWQ	1. A reduction in DASS-21 depression and stress scale was seen in 2 Individuals; anxiety scale in all three individuals. 2. Overall quality of life improved in 1 individual and remained the same in 2 individuals.
Perry et al., (2010) Australia PCT N=36	**Population:** Mean age=43.8yr; M/F=28/8; Level of injury: tetraplegia=13, paraplegia=20, Severity of injury: complete=13, incomplete=23; Duration of pain=60.5 mo; Type of pain=mixed. **Intervention:** Individuals with SCI and chronic pain were placed in either the multidisciplinary cognitive behavioural pain management program (PMPs) group which involved a pharmacological treatment plan and individual and group based CBT for pain; or the usual care group. **Outcome Measures:** Hospital Anxiety and Depression Scale (HADS).	1. A trend towards improvement on the HADS depression score was seen in the PMP group at 1 mo post treatment; however, the HADS depression scores returned to pre-treatment levels at 9 mo follow-up.
Norrbrink Budh et al., (2006) Sweden PCT N=38	**Population:** Treatment: Mean age=53.2yr; Gender: males=9, females=18; Level of injury: C=15, Th=6, L/S=6; Severity of injury: AIS: A=4, C=3, D=19, E=1; Controls: Mean age=49.9yr; Gender: males=5, females=6; Level of injury: C=4, Th=7; Severity of injury: AIS: A=6, D=5; Depression status=mixed. **Intervention:** The intervention group received education, Cognitive Behavioural Therapy (CBT), relaxation and body awareness training totaling 5 hr/wk for 10 wk while matched controls received no treatment for neuropathic pain. Depression was assessed as a secondary outcome. **Outcome Measures:** Hospital Anxiety and Depression Scale (HADS).	1. At 1 yr follow up, the sign test showed no significant change in depression levels HADS in the treatment group from baseline. 2. However, the treatment group showed systematic decrease in depression as measured by relative change in position (95% confidence interval) at 1 yr follow up. 3. Depression also decreased systematically in the treatment group compared to the control group at 1 yr follow up; however, the sign test showed no significant change

Author Year Country Research Design PEDro Score Total Sample Size	Methods	Outcome
Kennedy et al., (2003) United Kingdom Cohort $N_{Initial}$=85; N_{Final}=85	**Population:** SCI: Age=16-65 yr; Cause of injury: trauma; Chronicity=acute. Depression status=mild (BDI=15) **Intervention:** Consisted of 60-75 min sessions 2x/wk for 3.5 wk in small groups of 6-9 participants. Session topics were: normalizing stress, appraisal skills, problem solving, examination of thoughts feeling and behavior, awareness of negative assumptions, and choosing appropriate ways both to cope and to increase social supports. **Outcome Measures:** Beck Depression Inventory (BDI), State Trait Anxiety Inventory (STAI), Coping Strategies Scale (CSS), Self-Perception Scale (SPS), and Functional Impairment Measure (FIM). Measures were taken before and immediately after the intervention, and at a 6wk follow-up with the intervention group, and every 6 weeks with the historic control group.	1. Mood: Depression scores decreased for the intervention group following the intervention (p=0.001).
Craig et al., (1999) Australia Case Control $N_{Initial}$=58; N_{Final}=58	**Population:** SCI: Age=16-73 yr; Gender: males=57, females=12; Severity of injury: complete=68%-71%; Chronicity=acute. Depression status=mixed group. **Intervention:** 10 wk in small groups. Each session lasted 1.5-2 hrs replacing normal rehab therapy. Individuals underwent Cognitive Behavioural Therapy (CBT) attempts to change behaviour and feeling associated with the problem and considered maladaptive. Main aim of the program was to provide cognitive and behavioural skills to cope with the psychological and social difficulties encountered upon entering the community (as described above). **Outcome Measures:** Re-admissions, drug usage, relationships, social discrimination, self-reports of adjustment	Percentages are reported for each area measured. 1. Re-admission: More control were readmitted following discharge (p<0.05). 2. Drug usage: Controls were found to have higher self-reported drug usage than the treatment group (cases) (p<0.05). 3. Relationships and Social discrimination: No significant differences were noted between the two groups in relation to the types of relationship each person developed. Self-reports of adjustment: Treatment groups said they had a higher number of persons who felt they had adjusted well compared to the controls (p<0.01).
King & Kennedy (1999) United Kingdom PCT $N_{Initial}$=38; N_{Final}=38	**Population:** Age=16-65 yr; Chronicity=acute; Depression status=mild **Intervention:** Consisted of 60-75 min sessions 2x/wk with 6-9 people. Sessions included a mixture of didactic presentations, practical exercises and time allocated for open group discussions. Following components made up the program: appraisal training, cognitive behavioural coping skills training, and strategies for choosing an adaptive match between appraisals and coping skills, and obtaining and maintaining social support. **Outcome Measures:** Functional Impairment Measure (FIM), Social	Pre-intervention comparisons of groups: 1. The intervention group used religion significantly more and humour significantly less as coping strategies (p<0.05) than did controls. 2. There were no pre-intervention differences between the groups on range of injury, social support, FIM scores, other coping strategies, depression or anxiety. Post-intervention comparison of groups: 1. Across time there were significant decrease in the depression scores (p<0.05).

Author Year Country Research Design PEDro Score Total Sample Size	Methods	Outcome
	Support Questionnaire (SSQ), Beck Depression Inventory (BDI), State Trait Anxiety Inventory (STAI), COPE.	
Craig et al., (1998) Australia Cohort $N_{Initial}$=69; N_{Final}=58	**Population:** Treatment: Mean age=31yr; Gender: males=23; females=5; Depression status=mixed group **Intervention:** 10 wk inpatient program. Small groups (4-5/group) for 1.5 hr/wk. Major aim was to provide cognitive and behavioural skills to cope with the psychological and social difficulties encountered upon entering the community. Cognitive Behavioural Therapy (CBT) included muscle relaxation, visualization techniques, self-hypnosis and cognitive restructuring, social skills and assertiveness training, and sexuality sessions. **Outcome Measures:** State Trait Anxiety Inventory (STAI), Beck Depression Inventory (BDI).	1. Significant differences noted for depression overall, ($p<0.05$). 2. Both the treatment and the control groups appeared to be less depressed 1 and 2 yr after injury. 3. For individuals who scored high on the depression scale before therapy, (9 from each group) there were significant differences after treatment. ($p<.01$) with the control group reporting higher levels of depressive mood. 1. Depressive mood scores showed significant differences across time ($p<0.01$) with scores 1 and 2 yr post injury significantly lower than pretreatment scores ($p<0.01$).
Craig et al., (1997) Australia PCT N=69	**Population:** SCI: Age=16-73 yr; Gender: males=57, females=12; Severity of injury: complete=68%-71%; Chronicity=acute. Depression status=mixed group **Intervention:** 10 wk program. Small groups (4-5/group), for 1.5 hr/wk. Provided cognitive and behavioural skills to cope with the psychological and social difficulties encountered upon entering the community. Cognitive Behavioural Therapy (CBT) included muscle relaxation, visualization techniques, self-hypnosis and cognitive restructuring, social skills and assertiveness training, and sexuality sessions. **Outcome Measures:** State Trait Anxiety Inventory (STAI), Beck Depression Inventory(BDI), Rosenberg Self-Esteem scale.	2. Significantly greater self-esteem for treatment group ($p<0.01$). Taking this into account, no significant differences between the groups were found immediately after injury or 1 yr later. 3. No significant initial differences were found between the groups on anxiety and depression when comparing pre, post and 1 yr scores. 4. BDI scores were significantly lower for both conditions 1 yr after injury ($p=0.014$). 5. Those who scored>14 on the depressive mood scale were analyzed using repeated measures ANOVA. 22 persons (from both groups) were examined. Significant differences were noted between the groups ($p<0.01$). 6. Significant differences were also noted across time for the BDI scores ($p<0.01$). Post hoc tests showed that the treatment group had significantly greater levels of improvement across time ($p<0.05$).

Discussion

Several studies examined the effect of group CBT targeting mood among persons with SCI. Three studies found it was effective at reducing depressive symptoms post intervention compared to control groups (P. Kennedy et al., 2003; King & Kennedy, 1999; Li et al., 2019); while three studies found no significant difference in mood (Craig et al., 1997; A. Craig et al., 1998) (Coker et al.,2019;;. Craig et al.,(1997; 1998; 1998) (; 1999) found only a subgroup of

participants with Beck Depression Inventory scores greater than 14 experienced a significant reduction in depressive symptoms. Among this subgroup, decreased scores were maintained at 1 and 2 year follow-ups (A. Craig et al., 1998).

Several studies found significant improvement in depressive symptoms among individuals receiving CBT post intervention (Dorstyn et al., 2011; Duchnick et al., 2009; Feng & Li, 2017; Norrbrink Budh et al., 2006; Perry et al., 2010). Duchinick et al.,(2009) and Dorstyn et al.,(2011) found that the effect was not maintained at 3 month follow-up; Perry (2010) found the effect was not maintained at 8 month follow-up.

Four studies examined the effect of CBT targeting pain intervention on mood compared at usual care control group (Blake, Trinder, & Allen, 2018; Heutink et al., 2014; Heutink et al., 2012; Norrbrink Budh et al., 2006; Perry et al., 2010). Only one study which provided online CBT found significant improvement in depressive symptoms between the intervention and control group (Dear et al., 2018).

One study examined the effect of telecounselling CBT programs on mood and adjustment amongst persons with SCI (Dorstyn et al., 2012). Dorstyn et al.,(2012) reported symptoms were maintained over the follow-up period. Four studies examined the role of online CBT targeting mood resulting in significant reduction in depressive symptoms post intervention (Migliorini et al., 2016; Migliorini et al., 2011). Burke and colleagues (2019) found no significant difference in depressive symptoms in the intervention group compared to the control group post intervention; however, significant decrease in depressive symptoms were seen in the treatment group at 3 month follow-up. Verwer et al.,(2016) found no significant difference in depressive symptoms through a self-directed online CBT program.

Schulz et al.,(2009) conducted a CBT trial targeting both persons with SCI and their caregivers. The study found that the dual targeted group both the persons with SCI and caregivers had the greatest reduction in depressive symptoms compared to the group targeting only persons with SCI and information only control group.

Conclusion

There is level 2 evidence (Craig et al., 1997; A. Craig et al., 1998; A. Craig et al., 1999; A. R. Craig et al., 1998; Paul Kennedy & Rogers, 2000; King & Kennedy, 1999) to support the use group CBT intervention targeting mood to decrease depressive symptoms following SCI among those with elevated depressive symptoms.

There is level 1 evidence (Duchnick et al., 2009; Feng & Li, 2017) that CBT is effective in improving depressive symptoms post intervention.

There is conflicting evidence that CBT intervention results in maintained affective improvement at follow up.

There is level 1b evidence (Schulz et al., 2009) that providing CBT to caregivers and care receivers results in improved depressive symptoms in care receivers.

There is level 1 evidence (Dear et al., 2018; Dorstyn et al., 2011; Migliorini et al., 2011) that telerehabilitation or online based CBT improves symptoms of depression post SCI.

Individual based CBT is effective in reducing symptoms of depression post SCI; however the results may not be maintained at follow-up.

Cognitive behavioural interventions provided in a group setting appear helpful in reducing post-SCI depression among those with elevated symptoms of depression.

CBT interventions aimed at both caregivers and care receivers may be effective in reducing symptoms of depression post SCI.

Telerehabilitation or online CBT improves symptoms of depression post SCI.

3.3.2. Mindfulness for Depression following SCI

Table 3. Mindfulness for Depression following SCI

Author Year Country Research Design PEDro Score Total Sample Size	Methods	Outcome
Hearn and Finlay (2018) United Kingdom RCT PEDro=7 $N_{Initial}$=67 N_{Final}=43	**Population:** Mean age=44.4±10.4 yr; Gender: males=31, females=36; Time since injury (yr): 1-2=11, 2-4=18, 4-8=19, 8-12=6, 12-15=7, 15+=6; Level of injury: C=25, T=37, L=5; Severity of injury: AIS A=9, B=17, C=19, D=22. **Intervention:** Participants were randomized to either an 8-wk online mindfulness intervention or an 8-wk internet delivered psychoeducation. **Outcome Measures:** Depression symptom severity and anxiety (hospital anxiety and depression scale (HADS)), quality of life (QoL)(world health organization quality of life (WHOQOL-BREF) , pain perception (numeric rating scale), pain catastrophizing scale (PCS) and mindfulness (five facet mindfulness questionnaire (FFMQ).	1. Significant differences post-intervention between groups for mindfulness facets of acting with awareness, describing and non-reactivity to inner experience ($p<0.05$) as well as total FFMQ score ($p<0.05$). 2. No significant differences between groups for any QoL, pain intensity and mindfulness facets of observing and non-judging post-intervention ($p>0.05$). 3. Significant between group difference in severity of depression and pain catastrophizing at 3-mo follow-up ($p<0.050$).

Discussion

Hearn and Finlay (2018) evaluated the effectiveness of an 8-week online mindfulness program compared to pain psychoeducation among persons with SCI. Participants in the treatment group found significant reduction in symptoms of depression, anxiety, pain unpleasantness, and catastrophizing compared to the psychoeducation group at post treatment and 3-month follow-up.

Conclusion

There is level 1b evidence that online mindfulness programs can help reduce symptoms of depression post SCI (Hearn & Finlay, 2018).

Online chronic pain based mindfulness programs help reduce symptoms of depression among persons with SCI.

3.3.3 Peer Support for Depression following SCI

Table 4. Peer Support for Depression following SCI

Author Year Country Research Design PEDro Score Total Sample Size	Methods	Outcome
Mackelprang et al.,(2016) USA RCT PEDro=7 $N_{Initial}$=168 N_{Final}=165	**Population:** Mean age at injury=41.2±15.8 yr; Gender: males=133, females=35; Level and severity of injury: C1-C4 AIS A-C=34, C5-C8 AIS A-C=22, paraplegia AIS A-C=47, AIS D=63. **Intervention:** Participants were randomized to either peer telephone counselling (TC) group or a usual care (UC) group for a yr after spinal cord injury during rehabilitation. **Outcome Measures:** Self-reported health care utilization, medical complications, depression severity, current health state, subjective health and community participation.	1. No significant differences between groups for any outcome measures ($p>0.05$ for all).

Discussion

One study evaluated the effectiveness of a peer led telephone counselling program for persons with SCI compared to usual care. The study found no significant difference in depression severity or quality of life in the treatment group compared to the control group ($p>0.05$).

Conclusion

There is level 1b evidence that peer led telephone counselling may not be effective in reducing symptoms of depression.

Peer telephone counselling may not be effective in reducing symptoms of depression post SCI.

3.4 Combined Psychotherapy and Pharmacotherapy for Treatment of Depression in SCI

Overall, support for pharmacological treatment of depression in individuals with SCI is largely an extrapolation from the extant literature concerning use in the general population and comparative trials of medications and cognitive behavioural interventions are "*sorely needed*" (Elliott & Kennedy, 2004).

Table 5. Combined Psychotherapy and Pharmacotherapy for Treatment of Depression in SCI

Author Year Country Research Design PEDro Score Total Sample Size	Methods	Outcome
Kahan et al., (2006) USA PCT N=76	**Population:** Treatment group: SCI=28, Other conditions=26; Mean age=51.4 yr Gender: males=52.7%, females=46.3%; Time since injury=26.2 yr; Quasi control group: SCI=13, Other=9; Mean age=44.2 yr; Gender: males=45.5%, females=54.4%; Time since injury=18.8 yr. Depression status=major depression evaluated using Older Adult Health and Mood Questionnaire (OAHMQ). **Intervention:** Treatment group received a mixture of outpatient cognitive behavioral psychotherapy and antidepressant medication (individualized), for 30 wk. **Outcome Measures:** OAHMQ-depression; Life Satisfaction Scale (LSS), The Community Activities Checklist -community activity involvement. Treatment group: @ baseline (T1), 10 weeks (T2) & 30 weeks (T3). Control group: @ 2 points (routine medical visits) spanning 2 yr.	1. Depression Outcomes: Depression rate of the treatment group was improved between all time points (p≤0.001). 2. At baseline, OAHMQ scores in 53/54 treatment subjects classified as "experiencing major depression" and 1/54 had "significant depression symptoms". By T3, 41 subjects classification had improved and 13 remained the same with an improved OAHMQ score (p≤0.001). Overall, 71% of SCI subjects' depression improved following treatment. 3. At baseline, treatment and control groups' depression scores were similar, but were significantly different after treatment (p≤0.001). Mean depression scores reduced by 50% & 12% in treatment & control groups, respectively.
Kemp et al., (2004) USA PCT $N_{Initial}$=43 N_{Final}=28	**Population:** SCI: Age=20-74 yr; Gender: males 32; females=11; Time since injury=5-37 yr; 28 treated for depression, 15 acted as quasi-controls. Depression status=major depression using Older Adult Health and Mood Questionnaire (OAHMQ) **Intervention:** 6 mo of individual outpatient treatment. Two components: psychotherapy and medication were offered to all. Cognitive Behavioural Therapy (CBT) began once a week for the first 2 mo then was reduced to twice a mo. All were prescribed an antidepressant based upon their needs and physician's decision. Average number of therapy session completed was 14/17 (range 6-17). **Outcome Measures**: Older Adult Health and Mood Questionnaire (OAHMQ)Hamilton Depression Rating Scale (HDRS), Community activities checklist, Life Satisfaction Scale (LSS)	1. Depression Outcomes: A decrease was observed in depression scores from 0-24wk in the treatment group (p<0.001). 2. Paired t-tests indicated a 24% decline in depression scores from 0-8wk (time 1=15.7, time 2=11.9, p<0.001) and from 8-24 wk (6.7) (p<0.001). 3. 8 subjects continued to score in the range for major depression. If cases with variable treatment adherence were eliminated 100% of participants treated no longer had scores in the range of major depression. 4. A further increase was noted between 8 and 24 wk (time 2=15.5, time 3=22.3, p<0.001). The correlation between the change in number of depressive symptoms and the change in the # of community activities was high (-0.81, p<0.001). 5. Non-treatment group: Scores on the depression measure did not change significantly over time.
Judd et al., (1989) USA Pre-Post N=14	**Population:** Mean age=31.6 yr; Gender: males=9, females=5; Level of injury: paraplegia=7; tetraplegia=7; Depression status=clinically depressed evaluated using Diagnostic and Statistical Manual of Mental Disorders-III. **Intervention:** Individuals received supportive psychotherapy and were prescribed tetracyclic and tricyclic	1. 13 of the 14 individuals had improvement in BDI score at discharge (average BDI at discharge=8).

Author Year Country Research Design PEDro Score Total Sample Size	Methods	Outcome
	antidepressants during rehabilitation period. **Outcome Measures:** Beck Depression Inventory (BDI)	
Judd et al., (1986) USA Pre-Post N=9	**Population:** Mean age=45.6 yr; Gender: males=8, females=1; Level of injury: tetraplegia=5; paraplegia=4. Depression status=clinically depressed evaluated using Diagnostic and Statistical Manual of Mental Disorders -III. **Intervention:** Individuals were assessed within 2 wk of admission and prescribed either mianserin or nomifensine along with supportive psychotherapy. **Outcome Measures:** Hamilton Depression Rating Scale (HDRS)	1. All individuals showed improvement in depressive and anxiety symptoms.

Discussion

Two PCTs reported significant improvement in depressive symptoms in the combined CBT and antidepressant group compared to usual care (Kahan et al., 2006; Kemp et al., 2004). Two pre-post studies reported combined supportive psychotherapy and pharmacotherapy resulted in improvement of depressive symptoms amongst persons with SCI (Judd et al., 1986; Judd et al., 1989).

Conclusion

There is level 2 evidence (Kahan et al., 2006; Kemp et al., 2004) that combined CBT and antidepressants reduce symptoms of depression post SCI.

There is level 4 evidence (Judd et al., 1986; Judd et al., 1989) indicating the effectiveness of pharmacotherapy combined with supportive psychotherapy for reducing symptoms of depression in SCI.

Combining pharmacotherapy with CBT or supportive psychotherapy results in improved mood post SCI.

3.5 Pharmacotherapy for Depression following SCI

Pharmacotherapy is a commonly prescribed for treatment of depression post SCI. Poor tolerance to pharmacotherapy may lead to exacerbation of other secondary issues such as spasticity (Stolp-Smith & Wainberg, 1999). However, research on its efficacy among persons with SCI is limited.

Table 6. Pharmacotherapy for Treatment of Depression in SCI

Author Year Country Research Design	Methods	Outcome

PEDro Score Total Sample Size		
Fann et al., (2015) USA RCT PEDro=10 $N_{Initial}$=133 N_{Final}=126	**Population:** Mean age=40yr; Gender: males=99, females=34; Level of injury: paraplegia=70, quadriplegia=62, unknown=1; Severity of injury: incomplete=62, complete=71; Mean time post injury=11yr; Depression status=Major Depressive Disorder. **Intervention:** Individuals were randomized to receive venlafaxine extended-release (150mg/d, n=69) or placebo (control, n=64) for 12wk. Outcomes were assessed pre and post treatment. **Outcome Measures:** Hamilton Depression Rating Scale (HAM-D), Maier Subscale, Symptom Checklist 20 (SC-20).	1. There was no significant difference between groups in improvement on the HAM-D (p=0.42) or SC-20 (p=0.14). 1. On the Maier subscale, there was a significant improvement in the treatment group when compared to the control group (p=0.02).
Richards et al., (2015) USA RCT PEDro=10 $N_{Initial}$=133 N_{Final}=123	**Population:** Mean age=40.0±11.0 yr; Gender: males=99, females=34; Time since injury=10.9±10.6 yr; Level of injury: C=62, T=58, L=12; Severity of injury: AIS A=71, B=20, C=12, D=30. **Intervention:** Participants were randomized to either a venlafaxine XR group or a placebo group using a flexible titration schedule over the course of 12 wk. **Outcome Measures:** Numeric rating scale 0-10 (NRS) for pain intensity, pain interference items of the brief pain inventory (BPI)	2. No significant difference was seen in mood among those with neuropathic or mixed pain. 3. Significant improvement in mood was reported among those with nociceptive pain.
Salinas et al.,(2012) Colombia RCT PEDro=9 $N_{Initial}$=46 N_{Final}=44	**Population:** Mean age=36yr; Gender: males=42, females=4; Level of injury: paraplegia=28, quadriplegia=18; Severity of injury: incomplete=13, complete=33; Mean time post injury <2wk; Depression status=symptoms. **Intervention:** Individuals without neuropathic pain were randomized to receive carbamazepine (600mg/d, n=24) or placebo (control, n=22) for 1mo. Outcomes were assessed pre and post treatment, and at 3 and 6mo follow-up. **Outcome Measures:** Zung Self-Rating Depression Scale (ZSDS).	1. There was no significant between groups on the ZSDS at 1mo (p=0.829), 3mo (p=0.421), or 6mo (p=0.551).
Rintala et al., (2007) USA RCT Crossover PEDro=6 $N_{Initial}$=38 N_{Final}=22	**Population:** Mean age=41yr; Gender: males=36, females=2; Level of injury: paraplegia=18, quadriplegia=20; Mean time post injury=11yr; Depression status=symptoms. **Intervention:** Individuals with chronic neuropathic pain received amitriptyline (50mg, 3x/d), gabapentin (1200mg, 3x/d), and diphenhydramine (25mg, 3x/d, control) for 8wk each in a randomized sequence. Outcomes were assessed every 2wk during each drug trial. **Outcome Measures:** Center for Epidemiologic Studies Depression Scale – Short Form (CES-D-SF).	1. There was no significant change in CESD-SF scores across time for any medication. 2. There was no significant difference in CES-D-SF scores between the three medications at any given time point.

Discussion

Four studies examined the effect of pharmacotherapy alone in the reduction of depressive symptoms post SCI (Fann et al., 2015; Richards et al., 2015; Rintala et al., 2007; Salinas et al., 2012). Richards et al.,(2015) found venlafaxine resulted in significant improvement in pain interference of mood among those with noiciceptive pain compared to placebo. No significant effect of venlafaxine was seen among those with neuropathic or mixed pain. The remaining three studies found no significant improvement in depressive symptoms after amitriyptyline (Rintala et al., 2007), gababentin (Rintala et al., 2007), and carbamazepine (Salinas et al., 2012) compared to placebo. Fann et al.,(2015) reported significant decrease in depressive symptoms based on the Maier subscale of the HAM-D among persons receiving venlafaxine compared to placebo.

Conclusion

There is limited evidence that carbamazepine, amitriptyline, and gabapentin may not improve symptoms of depression post SCI

There is level 1b evidence (Fann et al., 2015) that venlafaxine improves depressive symptoms post SCI

There is level 1b evidence (Richards et al., 2015) that venlafaxine improves pain interference with mood post SCI

Venlafazine improves depressive symptoms post SCI.

3.6 Physical Interventions for Depression following SCI

3.6.1 Physical Activity for Depression following SCI

Strategies to encourage health, reduce secondary complications and consequently support positive emotional adjustment following SCI have emerged as a source of increasing research interest. As examples, the following studies review the impact of regular exercise upon various measures of physical health and emotional well-being.

Table 7. Physical Activity for Depression following SCI

Author Year Country Research Design PEDro Score Total Sample Size	Methods	Outcome
Akkurt et al., (2017) Turkey RCT PEDro=5 N=33	**Population:** Mean age: Not reported; Median age: Intervention group=33 yr, Control group=37 yr; Gender: males=29, females=4; Time since injury=>1 mo, not specified further; Level of injury: C=1, T=22, L=10; Severity of injury: AIS A=19, B=1, C=10, D=3. **Intervention:** Participants were enrolled in a 12-wk program comparing arm	1. No intergroup differences were seen in HADS and CES-D. 2. No statistically significant differences over the assessment period between the intervention and control groups in disability levels, QOL, or metabolic syndrome parameters (p=>0.05 for all).

Author Year Country Research Design PEDro Score Total Sample Size	Methods	Outcome
	ergometer exercises and general exercises to those that receive only general exercises. **Outcome Measures:** Psychological status (Center for Epidemiologic Studies Depression Scale and Hospital Anxiety and Depression Scale).	
Curtis et al., (2017) Canada RCT Crossover PEDro=6 N=22	**Population:** Yoga group (n=10): Mean age=47.9±19.5 yr; Gender: Not reported; Level of injury: paraplegia=6, tetraplegia=0, ambulatory/unspecified=4; Severity of injury: complete=2, incomplete/disease-related=8. Control group (n=12): Mean age=54.8±10.1 yr; Gender: Not reported; Level of injury: paraplegia=4, tetraplegia=4, ambulatory/unspecified=4; Severity of injury: complete=5, incomplete/disease-related=7. **Intervention:** Participants were randomized to a 6 wk, twice wkly Iyengar yoga group or a 6 wk wait-listed control group, then after the first yoga group completed their sessions, the wait-list control group engaged in the yoga protocol. **Outcome Measures:** Pain (brief pain inventory (BPI), pain catastrophizing scale (PCS)), psychological (acceptance and action questionnaire (AAQ), hospital anxiety and depression scale (HADS), general self-efficacy scale (GSES), posttraumatic growth inventory (PTGI-SF), Connor-Davidson resilience scale (CD-RISC), self-compassionate scale (SCS)) and mindfulness (five-facet mindfulness questionnaire (FFMQ) measures taken 1-2 wk before and after the program.	1. Yoga group had significantly lower scores for the HADS ($p<0.05$) and significantly higher scores for the SCS ($p<0.05$) at post-intervention than at baseline. 2. Fixed-factor models showed significantly lower HADS scores postintervention compared to preintervention ($p<0.05$) with time being the main predictor of HADS scores ($p<0.05$). 3. There was a trend noticed for FFMQ scores from preintervention to postintervention for total scores ($p=0.09$) and observing scores ($p=0.06$). 4. Postintervention scores for the SCS and FFMQ were both significantly higher than at preintervention ($p>0.05$).
Latimer et al., (2004) Canada RCT PEDro=1 N=23	**Population:** Intervention group: Mean age:37.54 yr; Gender: 9 males, 4 females; Level of injury: Tetraplegia (7), Paraplegia (6); Mean time post-injury: 9.23 yr; Control group: Mean age:43.30 yr; Gender: 5 males, 5 females; Level of injury: Tetraplegia (4), Paraplegia (6); Mean time post-injury:15.70 yr **Intervention:** Intervention group: A 6 mo exercise program 2d/wk in small groups (avg 3-5 people), ran by student volunteer personal trainers. Control group: Asked to continue normal daily activities and not begin an exercise routine within 6 mo	1. At baseline, ↑ stress levels were related to ↑ depression rates ($p<0.05$). At 6 mos, the exercise group's stress and depression association had ↓ but remained significant in the control group ($p<0.05$). 2. At baseline, ↑ stress levels were associated to ↓perceived QOL ($p<0.05$). At 3 and 6 mo the exercise group's stress and QOL association ↓, but remained ↑ across all time points for the control group ($p<0.05$). 3. Exercise was found to buffer the effects of stress on QOL and depression.

Author Year Country Research Design PEDro Score Total Sample Size	Methods	Outcome
	Outcome Measures: Perceived Stress Scale (PSS); Center for Epidemiologic Studies Depression Scale (CES-D); Perceived Quality of Life (PQOL); measured at at baseline, 3 and 6 mo	
Hicks et al., (2003) Canada RCT PEDro=8 $N_{Initial}$=43 N_{Final}=32	**Population:** Age=19-65 yr; Gender: both; Time since injury=1-24 yr. **Intervention:** Experimental group participated in a progressive exercise training program twice weekly for 9 mo on alternative day's 90-120 min starting with warm up, upper extremity stretching, and 15 to 30 min of aerobic training. As the rate of perceived exertion decreased, workload was increased. Some resistance training took place. **Outcome Measures:** Changes in depression, cardiovascular function, muscle strength and quality of life.	1. Quality of life components: Exercisers reported less stress, fewer depressive symptoms, and greater satisfaction with their physical functioning than the controls. (p=0.06). Exercisers reported less pain (p<0.01) and a better Q of L (p<0.05).
Martin Ginis et al., (2003) Canada RCT PEDro=6 $N_{Initial}$=34 N_{Final}=34	**Population:** Mean age=8.6 yr; Gender: 23 males, 11 females; Mean time post-injury: 10.4 yr **Intervention:** Intervention group: 5 min of stretching, 15 -30 min of aerobic arm ergometry exercise & 45-60 min of resistance exercise, 2d/wk, in small groups. Control group: Asked to continue normal daily activities and not begin an exercise routine for 3 mo **Outcome Measures:** Perceived Quality of Life (PQOL); Center for Epidemiologic Studies Depression Scale (CES-D).	1. After 3 months, when compared to controls, exercisers had: - ↑ QOL (p=0.007) - ↓depression (p=0.02)
Diego et al., (2002) USA RCT PEDro=8 N=20	**Population:** Mean age=39 yr; Gender: males=15, females=5; Level of injury: tetraplegia; Time since injury=>1 yr. **Intervention:** One group received a 40 min massage 2x/wk for 5 wk by a massage therapist while the other was taught an exercise routine that they performed 2x/wk for 5 wk on their own. **Outcome Measures:** State Trait Anxiety Inventory (STAI), Center for Epidemiologic Studies Depression Scale (CES-D).	1. CES-D scores obtained on first day versus last day assessment by group. Repeated measures ANOVA showed a group by day interaction effect (p<0.05). 2. T-tests revealed greater decrease in CES-D depression scores for the massage therapy group (p<0.05).
Crane et al., (2017) USA Pre-Post $N_{Initial}$=89 N_{Final}=45	**Population:** Intervention Group:Mean age=43.8±15.3 yr; Gender: males=34, females=11; Level of injury: Paraplegia=11, Tetraplegia (C1-C4)=4, Tetraplegia (C5-C8)=8, Other=22; Severity of injury: AIS A/B=23, C/D=22. **Intervention:** Participants engaged in a 3-mo physical therapy group exercise class, twice per wk.	1. Significant improvement in state of health as well as a significant increase in days per week of moderate to vigorous activity (p<0.05 for both). 2. Total Patient Health Questionnaire-2 depression scores were significantly lower at post-intervention assessment (p<0.05).

Author Year Country Research Design PEDro Score Total Sample Size	Methods	Outcome
	Outcome Measures: Pre-post intervention interviews about exercise frequency and intensity, perceived health, pain, mood, sleep and television watching habits.	3. Participant comments from the interviews reinforced the program's positive influence on their health.
Curtis et al., (2015) Canada Pre-Post N=11	**Population:** Mean age=48.4±15 yr; Gender: males=1, females=10; Time since injury=157.4±191.8 mo; Level of injury: complete=3, incomplete=6; unknown=1, not reported=1; Severity of injury: tetraplegia=2, paraplegia=6, unknown=1, not reported=2. **Intervention:** Participants took part in an 8-wk modified yoga program with assessments taken at baseline and post-intervention. **Outcome Measures:** Pain (Brief Pain inventory (BPI), Pain Catastrophizing Scale (PCS), fatigue (Fatigue Severity Scale (FSS), psychological factors (General Self-Efficacy Scale (GSES), The Positive and Negative Affect Scale (PANAS)) and mindfulness (Toronto Mindfulness Scale (TMS) through self-report.	1. 5 of the 11 participants finished at least 4 sessions and Fisher's exact test revealed that participants who were outpatients were significantly more likely to complete the program than in-patients ($p<0.05$). 2. No significant differences between baseline and exit scores for any measure ($p>0.05$).
Kennedy et al., (2006) United Kingdom Pre-Post N=35	**Population:** Gender: males=30, females=5; Age: 18-61 yr, Level of injury: paraplegia=20, tetraplegia=15. **Intervention:** Back-Up: 1 wk single or multi-activity course in an integrated, residential environment. Activities include skiing, horseback riding, waterskiing, canoeing, rappelling and gliding. Questionnaires were completed at baseline and end of 1 wk activity courses **Outcome Measures:** Life Satisfaction Questionnaire (LSQ), Hospital Anxiety and Depression Scale (HADS)	1. HADS scores demonstrated significant ($p<0.01$) improvement in anxiety levels over the duration of the course.
Hicks et al., (2005) Canada Pre-Post N=14	**Population:** Chronic incomplete SCI: N=14; Tetraplegic=11, Paraplegic=3; Gender: males=11, females=3; Age range=20-53 yr; Mean time post injury=7.4 yr; ASIA: B=2, C=12. **Intervention:** Body weight supported treadmill training (BWSTT) -robotic – up to 45 min, 3x/week, 144 sessions (12 mo). **Outcome Measures:** Center for Epidemiologic Studies Depression Scale(CES-D)	1. Increased life satisfaction and increased physical function satisfaction ($p<0.05$), after BWSTT. 2. No change in depression or perceived health.
Warms et al., (2004) USA Pre-Post N=16	**Population:** Gender: males=13, females=3; Mean age=43.2 yr; Mean time post injury=14.4 yr. **Intervention:** "Be Active in Life" program: included educational materials (2 pamphlets, 2 handouts), a home visit	1. Physical activity: Counts/day increased in 60% of subjects and self-reported activity increased in 69% of subjects, but both were not significant. 2. Depression: no change.

Author Year Country Research Design PEDro Score Total Sample Size	Methods	Outcome
	with a nurse (90 min. scripted motivational interview, goal and personal action plan establishment), and follow up calls at day 4, 7, 11 & 28 (approx. 8 min each). Program lasted for 6 wk, and had a final follow up 2 wk post-completion. **Outcome Measures:** Self Rated Health Scale (SRHS), Center for Epidemiologic Studies Depression Scale (CES-D)	
Guest et al., (1997) USA Pre-Post N=15	**Population:** Traumatic complete paraplegics; N=15; Gender: males=12, females=3; Mean age=28.8 yr; Mean time post injury=3.8 yr. **Intervention:** Electrically stimulated walking program-32-sessions, using the Parastep® FNS ambulation system. **Outcome Measures:** Tennessee Self-Concept Scale (TSCS), Beck Depression Inventory (BDI)	1. Physical Self-Concept: decreased after electrically stimulated walking ($p<0.05$). Those with lower baseline score had the most significant improvements. 2. Depression: decreased after electrically stimulated walking ($p<0.05$).
Bradley et al., (1994) USA Cohort N=37	**Population:** Gender: males=24, females=13; Mean age=32.03 yr; Level of injury: tetraplegic=12, paraplegic=25; Mean time post injury=6.51 yr **Intervention:** Intervention group: 3 mos. Functional Electrical Stimulation (FES) exercise program; Control group: no intervention. **Outcome Measures:** Multiple Affect Adjective Check List (MAACLR)	1. Increased in depression & hostility for those who had unrealistic expectations of the FES program ($p<0.01$ & $p<0.05$, respectively).

Discussion

Several studies (Akkurt et al., 2017; Crane et al., 2017; Hicks et al., 2003; Latimer et al., 2004; Martin Ginis et al., 2003) evaluated the effect of exercise programs which included stretching, aerobic arm ergometry and resistance exercises among those with SCI. The studies found significant reduction in depressive symptoms post SCI post-treatment (Crane et al., 2017; Hicks et al., 2003; Latimer et al., 2004; Martin Ginis et al., 2003).

A Canadian pre-post study Hicks et al., (2005) examined the effect of Body weight supported treadmill training provided three times a week. This study reported an increase in life satisfaction and physical function satisfaction after 1 year of exercise; however, there was no change in reports of depressive symptoms.

Two studies (K. Curtis et al., 2017; K. J. Curtis et al., 2015) evaluated the effectiveness of yoga among persons with SCI. Curtis et al.,(2017) found participants receiving twice weekly yoga had a significant decrease in depressive symptoms compared to the waitlist control group. While, a pre-post study found no effect of yoga among those with SCI (K. J. Curtis et al., 2015).

Two studies, (Bradley, 1994; Guest et al., 1997) examined the effects of an electrically stimulated walking program on individuals with SCI. In a cohort study, Bradley (1994) reported a

significant increase in depression in participants with “unrealistic” expectations of their program. In contrast, Guest et al., (1997) used a pre-post design and found a decrease in reported depression after completion of their study intervention.

Warms et al., (2004) reported no change in participant depression levels after six weeks of increased physical activity through a “Be Active in Life” intervention program. A pre-post study (P. Kennedy et al., 2006), found an intensive 1-week residential program (“Back Up”) involving participation in recreational activities resulted in fewer symptoms of anxiety and depression.

Conclusion

There is level 1a evidence (from three randomized controlled trials; (Hicks et al., 2003; Latimer et al., 2004; Martin Ginis et al., 2003) that small group exercise based programs reduced depressive symptoms post SCI.

There is level 4 evidence that body weight supported treadmill training (Hicks et al., 2005), or functional electrical stimulation exercise (Bradley, 1994) may not improve symptoms of depression post SCI.

There is level 1b evidence (K. Curtis et al., 2017) that yoga improves depressive symptoms post SCI.

There is level 4 evidence (Guest et al., 1997) that Parastep FNS ambulation training may result in decrease in depressive symptoms post SCI.

There is level 4 evidence (P. Kennedy et al., 2006) that integrating sports and recreational activities may result in reduction of depressive symptoms post SCI.

Small group exercise programs improve depressive symptoms in persons with SCI.

Yoga improves depressive symptoms.

Body weight supported treadmill training may not improve symptoms of depression post SCI.

Parastep FNS ambulation training may improve symptoms of depression.

Increased sport and recreational activities may improve depressive symptoms.

3.6.2 Massage for Depression following SCI

Table 8. Massage for Depression following SCI

Author Year Country Research Design PEDro Score Total Sample Size	Methods	Outcome
Chase et al., (2013) USA RCT Crossover PEDro=6 N=40	**Population:** Mean age=40.24yr; Gender: males=33, females=7; Level of injury: paraplegia=7, quadriplegia=33; Severity of injury: incomplete=17, complete=23; Mean time post	1. PHQ-9 score was reduced significantly more in the LCT-BCM group than in the BCM-LCT group during wk1 (p=0.0085), but not during wk 2 (p=0.0747).

Author Year Country Research Design PEDro Score Total Sample Size	Methods	Outcome
	injury=69.35d; Depression status=symptoms. **Intervention:** Individuals with any form of pain received compression massage (BCM) and light contact touch (LCT) in a randomized sequence during six 20min sessions over 2wk. Outcomes were assessed pre and post each week. **Outcome Measures:** Patient Health Questionnaire-9 (PHQ-9).	
Diego et al., (2002) USA RCT PEDro=8 N=20	**Population:** Mean age=39 yr; Gender: males=15, females=5; Level of injury: tetraplegia; Time since injury=>1 yr. **Intervention:** One group received a 40 min massage 2x/wk for 5 wk by a massage therapist while the other was taught an exercise routine that they performed 2x/wk for 5 wk on their own. **Outcome Measures:** State Trait Anxiety Inventory (STAI), Center for Epidemiologic Studies Depression Scale (CES-D).	1. CES-D scores obtained on first day versus last day assessment by group. Repeated measures ANOVA showed a group by day interaction effect ($p<0.05$). 2. t-tests revealed greater decrease in CES-D depression scores for the massage therapy group ($p<0.05$).

Discussion

Two studies found the massage was effective in reducing symptoms of depression post SCI (Chase et al., 2013; Diego et al., 2002). Diego et al.,(2002) found that participants who received twice weekly massage for 5 weeks had greater reduction in depressive symptoms than those that participated in a 5 week exercise program. A second study reported that light contact touch as more effective at reducing symptoms of depression than compression massage (Chase et al., 2013).

Conclusion

There is level 1b evidence (Diego et al., 2002) that massage may be effective in reducing symptoms of depression post SCI.

Massage may be effective in reducing symptoms of depression.

3.7 Physical Stimulation Interventions for Depression following SCI

Table 9. Physical Stimulation for Depression following SCI

Author Year Country Research Design PEDro Score Total Sample Size	Methods	Outcome
Tan et al., (2011) USA RCT PEDro=8 $N_{Initial}$=105 N_{Final}=100	**Population:** Mean age=52yr; Gender: males=90, females=15; Level of injury: paraplegia=66, quadriplegia=37, unknown=2; Severity of injury: incomplete=52, complete=42,	1. At baseline, the treatment group had significantly poorer scores on CES-D-SF ($p<0.05$). 2. There was no significant main effect of time on CES-D-SF.

Author Year Country Research Design PEDro Score Total Sample Size	Methods	Outcome
	unknown=11; Mean time post injury=15yr; Depression status=symptoms. **Intervention:** Individuals with chronic neuropathic pain were randomized to receive active cranial electrotherapy stimulation (CES, treatment; n=46) or sham CES (control, n=59) 1hr/d for 21d. Outcomes were assessed pre and post treatment. **Outcome Measures:** Center for Epidemiologic Studies Depression Scale – Short Form (CES-D-SF), State-Trait Anxiety Inventory – Short Form (STAI-SF).	3. There were no significant time x group interactions on CES-D-SF.
Defrin et al., (2007) Israel RCT PEDro=10 N=12	**Population:** Mean age=54 yr; Gender: males=7, females=4. **Intervention:** Individuals were randomly placed into two groups: real or sham 10 daily motor repetitive transmagnetic stimulation (rTMS) treatments (500 trains at 5 Hz for 10s; total of 5000 pulses at intensity of 115% of motor threshold) over a 2 wk period, using figure-of-8 coil over the vertex. Primary outcome measure was of pain; while depression was a secondary outcome measure for the treatment. **Outcome Measures:** Beck Depression Inventory (BDI)	1. Real and sham TMS groups showed a significant decrease in BDI values following the treatment period in comparison to pretreatment BDI values ($p<0.01$). 2. This reduction was maintained by both groups at follow-up (4.5 wk) ($p<0.01$). 3. Only individuals in the rTMS treatment group exhibited a decreased level of depression during follow-up in comparison to the values at the end of treatment ($p<0.05$).
Fregni et al.,(2006) USA RCT PEDro=8 $N_{Initial}$=17 N_{Final}=15	**Population:** Mean age=35yr; Gender: males=14, females=3; Level of injury: paraplegic=8, quadriplegic=9; Severity of injury: incomplete=6, complete=11; Mean time post injury=3.5yr; Depression status=symptoms. **Intervention:** Individuals with central pain were randomized to receive active transcranial direct current stimulation (tDCS, treatment; n=11) or sham tDCS (control, n=6) 20min/d for 5d. Outcomes were assessed at baseline, 1-5d pre and post treatment, and 16d follow-up. **Outcome Measures:** Beck Depression Inventory (BDI), Visual Analogue Scale-Anxiety (VAS-A).	1. On BDI, there was no significant effect of time ($p=0.82$), group ($p=0.43$), or time x group interaction ($p=0.94$).

Discussion

Three studies evaluated the using of physical stimulation interventions in reducing depressive symptoms post SCI (Defrin et al., 2007; Fregni et al., 2006; Tan et al., 2011). One RCT by Defrin et al., (2007) evaluated the effectiveness of transmagnetic stimulation in reducing pain post-SCI. This study found a significant decrease in depression in individuals treated with transmagnetic stimulation compared to those in the control group at time of follow-up 2-6 weeks

post treatment. No significant effects were seen of transcranial electrical stimulation or transcranial direct current stimulation (Fregni et al., 2006; Tan et al., 2011).

Conclusion

There is level 1b evidence (from one randomized controlled trial; (Defrin et al., 2007) for the effectiveness of repetitive transmagnetic stimulation in reducing depressive symptoms.

Repetitive transmagnetic stimulation may improve symptoms of depression post SCI.

3.8 Miscellaneous Interventions for Depression following SCI

3.8.1 Hyperbaric Oxygen for Depression following SCI

Table 10. Hyperbaric Oxygen for Depression following SCI

Author Year Country Research Design PEDro Score Total Sample Size	Methods	Outcome
Feng et al.,(2017) China RCT PEDro=6 N=60	**Population:** HBO group (n=20): Mean age=36.1±5.2 yr; Gender: males=14, females=6; Level of injury: C=7, T=8, L=5; Severity of injury: AIS A=0, B=12, C=5, D=3. Psychotherapy group (n=20): Mean age=34.8±4.7 yr; Gender: males=15, females=5; Level of injury: C=8, T=6, L=6; Severity of injury: AIS A=0, B=10, C=8, D=2. Conventional rehabilitation group (n=20):Mean age=33.1±4.6 yr; Level of injury: C=7, T=9, L=4; Severity of injury: AIS A=0, B=10, C=7, D=3. **Intervention:** Participants were randomly allocated to either a hyperbaric oxygen group (HBO), a psychotherapy group or a conventional rehabilitation group for an 8-wk intervention in which all three groups received routine rehabilitation on top of their intervention. Therapy sessions occurred once a day, 6 days a wk for 8 wk. **Outcome Measures:** Hamilton depression scale (HAMD), Hamilton anxiety scale (HAMA), American spinal injury association score (AISA) and functional independence measure (FIM).	1. HAMD score was significantly lower in both the HBO and psychotherapy groups compared to the control group at the end of 8 wk ($p<0.05$ for both) with no significant difference between HAMD score for HBO and psychotherapy groups from baseline to 8 wk ($p>0.05$). 2. HAMA score was significantly lower for the HBO group than for the control group ($p<0.05$) with no significant difference in HAMA score between the HBO and psychotherapy groups ($p>0.05$).

Discussion

One study evaluated the effectiveness of hyperbaric oxygen in reducing symptoms of depression compared to psychotherapy group and a conventional rehabilitation group (Feng & Li, 2017). The study found both HBO and psychotherapy groups had significant reduction in symptoms of depression compared to conventional rehabilitation group.

Conclusion

There is level 1b evidence (Feng & Li, 2017) that hyperbaric oxygen may improve depressive symptoms post SCI.

Hyperbaric oxygen may improve depressive symptoms.

3.8.2 Education for Depression following SCI

Table 11. Education for Depression following SCI

Author Year Country Research Design PEDro Score Total Sample Size	Methods	Outcome
Zemper et al., (2003) USA RCT PEDro=4 $N_{Initial}$=67 N_{Final}=43	**Population:** Participants recruited from an outpatient clinic or Center for Independent living. Intervention group was more educated and had fewer retirees despite random assignment. SCI: Mean age=47 yr; Gender: males=30, females=13; Level of injury: paraplegia=42%, tetraplegia=39%, ambulatory=3%; Mean time since injury=14 yr; Marital status: single=28%, married=23%, divorced=8%. **Intervention:** A series of six 4 hr workshop sessions held over a 3 mo period, promoting health and wellness. Sessions included lifestyle management, physical activity, nutrition, preventing secondary conditions, individual coaching sessions, follow-up phone calls during the 4 mo following the workshops. Controls participated in pre/post assessment but received no intervention. **Outcome Measures:** Health Promoting Lifestyle Profile II (HPLP II), Secondary Conditions Scale (SCS), Self-rated Abilities for Health Practices Scale (SAHP), Physical Activities with Disabilities Scale (PADS)	1. The intervention group showed statistically significant improvement after intervention in several areas as compared to the control group: SAHP: ($p<0.05$) HPLP-II: ($p<0.001$). Nutrition HPLP-II subscale: improvement in nutritional awareness and behaviour ($p<0.05$) Stress HPLP-II subscale: Increased use of stress management techniques and decreases in perceived stress ($p=.001$). 1. SCS: fewer and less serious secondary conditions ($p<0.001$) Depression was less though did not reach significance.
Federici et al., (2019) Italy Pre-Post N=11	**Population:** Mean age: males=50.4±7.3 yr, females=41.5±11.26 yr; Gender: males=5, females=6; Time since injury=30.1±9.4 yr; Level of injury: tetraplegia=3, paraplegia=4, no paraplegia/tetraplegia=4; Severity of injury: complete=5, incomplete=2, none=4. **Intervention:** Participants were 4 couples (one with SCI and one without) and 3 singles with SCI who took part in	2. All participants improved significantly on item 5 of the SIS scale "How are your opportunity and your ability to enjoy sexuality yourself?" ($p<0.01$), SIS scale total score ($p<0.05$) and BAI scores ($p<0.05$). 3. No difference was found for SIS scale's general satisfaction after injury or for BDI ($p>0.05$). 4. Significant effect found on item 5 of the SIS scale "How are your opportunity and your ability to enjoy

Author Year Country Research Design PEDro Score Total Sample Size	Methods	Outcome
	a sexual health psychoeducational intervention in which 4 couples and 3 singles met every two weeks for 12 meetings of a growth group and reported the results of their love lives and persona lives. **Outcome Measures:** Sexual interest and satisfaction scale (SIS), Beck depression inventory – II (BDI-II) and Beck anxiety inventory (BAI).	sexuality yourself?" for both individuals and partners ($p<0.05$ for both).
Dunn et al., (2000) USA PCT $N_{Initial}$=371 N_{Final}=371	**Population:** Gender: mixed group-with more males; Mean time since injury=18.44 yr. **Intervention:** Follow-up after initial rehabilitation was completed addressing the secondary conditions post-SCI as well as the primary effects of their spinal cord injury. The focus is wellness, health promotion, and illness prevention through a continuum of coordinated care. **Outcome Measures:** Secondary Conditions Scale (SCS); Check Your Health Questionnaire (CYHQ).	1. An overall difference between the two groups was found ($p=0.0004$). 2. Medical Follow-up group reported a significantly higher subjective rating than did the No-F/U group on 3 variables: Health ($p=0.0068$), Independence ($p=0.005$), Absence of depression ($p<0.0001$). (Fisher's protected least significant diff. test). 3. A MANOVA showed a main effect on education on health, independence and absence of depression ($p=0.0098$). Further analysis showed that as education increased subjects reported greater health, and independence and lower depression.

Discussion

Three studies evaluated the effect of education program in reducing symptoms of depression post SCI (Dunn et al., 2000; Federici et al., 2019; Zemper et al., 2003). Two programs involved education regarding wellness and health promotion (Dunn et al., 2000; Zemper et al., 2003). Zemper (2003) found no significant improvement in depressive symptoms; while, Dunn (2000) found that the intervention resulted in decreased depressive symptoms. Federici et al.,(2019) provided sexual health psychoeducation over 12 sessions and found no significant improvement in depressive symptoms.

Conclusion

There is conflicting evidence for the effectiveness of education programs in reducing depressive symptoms post SCI (Dunn et al., 2000; Federici et al., 2019; Zemper et al., 2003).

Education may not improve depressive symptoms post SCI.

4.0 Anxiety

Anxiety significantly contributes to disability among persons with SCI with up to 45% of individuals experiencing excessing worry, fear or panic (Le & Dorstyn, 2016). The effects of

anxiety are often triggered among those with traumatic injuries. However, those with non-traumatic origins also experience anxiety related to their secondary conditions.

4.1 Prevalence of Anxiety Post-SCI

Prevalence rates of anxiety among those with SCI vary due to differing definitions and outcome measures utilized. Additionally, outcome measures may inflate prevalence estimates due to overlap of somatic symptoms related to secondary complications experienced by those with SCI including blood pressure, motor weakness, and respiratory function (Julian, 2011). However, some use of self-report measures to estimate prevalence may lead to underreporting due to socially desirable responding by individuals (Hunt, Auriemma, & Cashaw, 2003). A meta-analysis found that 27% of individuals reported clinically significant symptoms of anxiety (Le & Dorstyn, 2016). Anxiety estimates were found to be similar among hospital and community samples (27 versus 29%) (Le & Dorstyn, 2016). Longitudinal studies demonstrate levels do not diminish over time of up to 2 years post injury (AR Craig, Hancock, & Dickson, 1994).

4.2 Interventions for Management of Anxiety following SCI
4.2.1 Psychological Interventions

4.2.1.1 Cognitive Behavioural Therapy

Table 12. Cognitive Behavioural Therapy

Author Year Country Research Design PEDro Score Total Sample Size	Methods	Outcome
Burke et al., (2019) Ireland RCT PEDro=8 $N_{Initial}$=69 N_{Final}=57	**Population:** Mean age=52±13 yr; Gender: males=52, females=17; Time since injury=16±12.1 yr; Level of injury: C=17, T=30; L=14, Not reported=8; Severity of injury: AIS A=4, B=2, C=3, D=4, Not reported=55. **Intervention:** Participants were randomly assigned to either a control group where they went about their normal routine and the intervention group received an online six module cognitive behavioural therapy pain management program once per wk for 12 wk. **Outcome Measures:** World Health Organization Quality of Life Bref (WHOQOL-Bref), International Spinal Cord injury Quality of Life Basic Data Set (ISCIQOLBDS), International Spinal Cord Injury Pain Basic Data Set (ISCIPBDS), Douleur Neuropathique en 4 Questions (DN4), Chronic Pain Acceptance Questionnaire 8 (CPAQ8), Brief Pain Inventory (BPI), Hospital Anxiety and Depression Scale (HADS) and Pittsburgh Sleep Quality Index (PSQI).	1. Moderate linear relationship found between the number of modules in which the users engaged in 80% or more of the content and reductions in overall pain intensity ((NRS) (p=0.05), the ISCIPBDS pain interference score (p=0.08), the LSF domain (p=0.039), the BPI interface scale (p=0.10) and the depression subscale of the HADS (p=0.10). 2. At 3-mo follow-up a moderate linear relationship between module engagement and improvements in sleep quality (p=0.06), the AMS subcategory of the ISCIPBDS (p=0.09) and both the depression (p=0.03) and anxiety (p=0.05) subscales of the HADS.
Coker et al., (2019) USA RCT	**Population:** Control Group (n=40): Mean age=52±15.3 yr; Gender: males=32, females=8; Time since injury=81.5 mo; Level of injury:	1. Non-significantly greater increase in MSES for the treatment group compared

Author Year Country Research Design PEDro Score Total Sample Size	Methods	Outcome
PEDro=8 N=81	complete=16, incomplete=24; Severity of injury: AIS A=16, B=3, C=8, D=13. Intervention Group (n=41): Mean age=48±12.8; Gender: males=34, females=7; Time since injury=95 mo; Level of injury: complete=19, incomplete=22; Severity of injury: AIS A=19, B=2, C=7, D=13. **Intervention:** Participants were randomized to either a control group in which they continued their normal rehabilitation or an intervention group in which they took part in an interactive cognitive behaviour therapy based learning program for one session per wk, 2 hrs per session for 6 wk with assessments at baseline, post intervention and at 8-wk intervals post intervention. **Outcome Measures:** Moorong Self-Efficacy Scale (MSES), Generalized Self-Efficacy Scale (GSES), Diener Satisfaction with Life Scale (SWLS), Participation Assessment with Recombined Tools – Objective (PART-O), Patient Health Questionnaire – 9 (PHQ-9), and General Anxiety Disorder 7-Item (GAD-7).	to the control group from baseline to 6-wk and neither group showed significant difference from baseline to the 30-wk follow-up (p=0.15). 2. The treatment group showed significant improvements for the GSES, PHQ-9 and GAD-7 from baseline to 6-wk whereas the control group did not. 3. Neither group showed significant changes in SWLS or PART-O from baseline to 6-wk. 4. Despite the significant differences for the treatment group from baseline to 6-wk or from baseline to 30-wk follow-up, there are no significant differences in results between treatment and control.
Migliorini et al., (2016) Australia RCT PEDro=8 $N_{Initial}$=59 N_{Final}=48	**Population:** Intervention group (n=34): Mean age=47.5±12.2 yr; Gender: males=25, females=9; Time since injury=11.4±11.9 yr; Level of injury: complete paraplegia=5, incomplete paraplegia=8, complete tetraplegia=1, incomplete tetraplegia=18, unknown=2. Waitlist control group (n=25): Mean age=52.8±12.9 yr; Gender: males=17, females=8; Time since injury=19.8±14.0 yr; Level of injury: compete paraplegia=7, incomplete paraplegia=13, complete tetraplegia=2, incomplete tetraplegia=2, unknown=1. **Intervention:** Participants were randomized to either an Electronic Personal Administration of Cognitive Therapy (ePACT) group in which the participants completed 10-module skills or a Waitlist Control group with assessments at baseline, 3 mo follow-up and 6 mo follow-up. **Outcome Measures:** Depression, anxiety and stress scale-short (DASS21), personal well-being index, helplessness subscale and score above normative threshold of the depression, anxiety and stress scale-short form (DASS21).	1. 71 individuals accepted the option to try the ePACT, but 12 did not complete the intake process and those that completed the intake process and those that did not only differed significantly with regards to stress scores (p=0.05). 2. No significant differences between groups at baseline besides for time since injury (p=0.02) and level of injury distribution. 3. Dropouts from the intervention group did not differ significantly from those that did not drop out in any outcome measure. 4. At post-intervention, the ePACT group showed a significant reduction in depression, anxiety and stress and satisfaction with life significantly improved (p<0.05 for all) while the waitlist control group improved significantly with a reduction in depression (p=0.01).

Author Year Country Research Design PEDro Score Total Sample Size	Methods	Outcome
		5. Significant reductions in depression, anxiety and stress were maintained from post-intervention to 6 mo follow-up, and even reduced even more, albeit insignificantly.
Dorstyn et al., (2012) Australia RCT PEDro=6 $N_{Initial}$=40 N_{Final}=39	**Population:** Age=53.5yr; Gender: males=28, females=12; Level of injury: paraplegia=24, quadriplegia=16; Anxiety status=symptoms. **Intervention:** Individuals were randomly assigned to receive biweekly telecounselling for 20min over 12wk (n=20, treatment) or standard inpatient care (n=20, control). **Outcome Measures:** Depression Anxiety Stress Scale-21 (DASS-21).	1. Small improvements in DASS-21 depression (d=0.32), anxiety (d=0.24) and stress levels (d=0.27) were found in the treatment group compared to the control group post intervention. 2. Of the 8 individuals in the treatment group that reported mild, moderate or severe levels of depression and/or anxiety, 4 reported no symptoms post intervention. 3. Individuals in the control group reported increases in clinically significant symptoms of depression and/or anxiety over time.
Heutink et al., (2012) Netherlands RCT PEDro=6 $N_{Initial}$=61 N_{Final}=59	**Population:** Mean age=58.8yr; Gender: males=39, females=22; Level of injury: paraplegia=42, quadriplegia=19; Severity of injury: incomplete=39, complete=22; Anxiety status=symptoms. **Intervention:** Individuals with chronic neuropathic pain were randomly assigned to receive a multidisciplinary Cognitive Behavioural Therapy (CBT, n=31) program or waitlist group (n=30). The intervention consisted of 10 sessions over 10wk and afollow-up session 3wk later. **Outcome Measures:** Hospital Anxiety and Depression Scale (HADS).	1. Individuals in the CBT group found significant improvement in HADS-anxiety ($p<0.027$) and participation ($p<0.008$) compared to the waitlist group.
Duchnick et al.,(2009) RCT PEDro=4 $N_{Initial}$=41 N_{Final}=35	**Population:** Mean age=52.6yr; Gender: males=40, females=1; Level of injury: paraplegia=19, quadriplegia=22; Severity of injury: incomplete=31, complete=10; Mean time post injury=53.2d; Anxiety status=symptoms. **Intervention:** Participants were randomly allocated to either coping effectiveness training (CET, n=20) or supportive group therapy (SGT, n=20). CET focused on stress appraisal, problem solving, communication skills, behavioral strategies, cognitive strategies and social support. SGT emphasized sharing experiences and information related to SCI, emotional and cognitive reactions, and support from peers and therapist. Each inpatient group met 1x/wk for 60min. Outcomes	1. Significant decreases in STAI scores were seen at discharge in both groups ($p<0.05$). 2. STAI ($p<0.001$) scores increased significantly between discharge and follow-up in both groups. 3. STAI was not affected by group.

Author Year Country Research Design PEDro Score Total Sample Size	Methods	Outcome
	were assessed pre and post treatment, and at 3mo follow-up. **Outcome Measures:** Center for Epidemiologic Studies Depression Scale (CES-D), State Trait Anxiety Inventory (STAI).	
Dear et al., (2018) Australia Pre-Post N=68	**Population:** Mean age=48.0±13.0 yr; Gender: males=34, females=34; Time since injury=8.0±10.0 yr; Severity of injury: : complete=15, incomplete=44, unsure=9. **Intervention:** Participants completed five online lessons and homework tasks for pain management with weekly support from a clinical psychologist. **Outcome Measures:** Pain disability index (PDI), patient health questionnaire 9-item (PHQ-9), generalized anxiety disorder scale 7-item), Wisconsin brief pain questionnaire (WBPQ), pain self-efficacy questionnaire (PSEQ), pain catastrophizing scale (PCS), satisfaction with life scale (SWLS).	1. Significant overall effect observed for pain-related disability ($p<0.001$), anxiety ($p<0.001$) and depression ($p<0.001$), as well as improvements in all three from baseline to post-treatment ($p<0.001$) and even further improvements at 3-mo follow-up ($p<0.015$). 2. Significant overall time effect observed for pain self-efficacy ($p<0.001$), pain catastrophizing ($p<0.001$) and life satisfaction ($p<0.001$). 3. Significant improvements from baseline to post-treatment for pain catastrophizing and life satisfaction ($p<0.001$) with life satisfaction improving from post-treatment to follow-up ($p=0.006$) but not pain catastrophizing ($p=0.062$).
Heutink et al. (2014) Netherlands Follow-Up N=29	**Population:** Mean age=56.5yr; Gender: males=21, females=8; Level of injury: paraplegia=18, quadriplegia=11; Severity of injury: incomplete=14, complete=15; Mean time post injury=5.4yr; Anxiety status=symptoms. **Intervention:** Participants who received treatment in Heutink et al.,(2012) were assessed at at 6, 9, and 12mo follow-up. **Outcome Measures:** Hospital Anxiety & Depression Scale (HADS).	1. HADS-anxiety scores significantly decreased across from pre- to post-treatment, to 6mo, and to12mo ($p<0.05$).
Dorstyn et al., (2011) Australia PCT $N_{Initial}$=24 N_{Final}=19	**Population:** Mean age=48.5yr; Gender: males=20, females=4; Level of injury: paraplegia=14, quadriplegia=10; Severity of injury: incomplete=5, complete=19; Anxiety status=symptoms. **Intervention:** Participants with moderate to severe DASS-21 scores received Cognitive Behavioural Therapy (CBT, treatment, n=11) and those with subclinical scores received standard care (control, n=13). CBT was delivered via 7-22 sessions, each for 30-60mins. The treatment group was also prescribed low dose amitriptyline. Outcomes were assessed pre and post treatment, and at 3mo follow-up.	2. DASS-21 total scores did not change significantly over time in the treatment group. 3. DASS-21 total scores, anxiety subscores and stress subscores decreased post treatment and increased at follow-up. 4. DASS-21 scores did not change significantly over time in the control group.

Author Year Country Research Design PEDro Score Total Sample Size	Methods	Outcome
	Outcome Measures: Depression Anxiety Stress Scale-21 (DASS-21).	
Migliorini et al., (2011) Australia Pre-Post N=3	**Population:** Age range=41-65yr; males=2, females=1; Severity of injury: incomplete=2, complete=1; Anxiety status=symptoms. **Intervention:** Participants were offered a computer based Cognitive Behavioural Therapy (CBT) intervention involving 10 modules. **Outcome Measures:** Depression Anxiety Stress Scale-21 (DASS-21), Symptoms Checklist-90 (SCL-90), Personal Wellbeing Index (PWI), Emotional Wellbeing Questionnaire (EWQ).	1. DASS-21 anxiety score decreased in all 3 individuals.
Perry et al. (2010) Australia PCT $N_{Initial}$=36 N_{Final}=30	**Population:** Mean age=44yr; Gender: males=28, females=8; Level of injury: paraplegia=20, quadriplegia=13, Severity of injury: incomplete=23, complete=13; Mean time post injury=70.5mo; Anxiety status=symptoms. **Intervention:** Individuals with chronic neuropathic pain received either a multidisciplinary cognitive behavioural pain management program (treatment, n=19) or standard care (control, n=17). Treatment involved 10 sessions and pharmacotherapy over 6mo. Outcomes were assessed pre and post treatment, and at 1mo and 9mo follow-up. **Outcome Measures:** Hospital Anxiety and Depression Scale (HADS).	1. HADS-anxiety scores significantly improved over time in the treatment group when compared to the control group (p=0.007).
Norrbrink Budh et al. (2006) PCT N=38	**Population:** Mean age=52yr; Gender: males=14, females=24; Level of injury: paraplegic=19, quadriplegic=19; Severity of injury: incomplete=28, complete=10; Mean time post injury=12yr; Anxiety status=symptoms. **Intervention:** Individuals with neuropathic pain received cognitive behavioural therapy, education, relaxation, and body awareness training (treatment, n=27) while matched controls received no treatment for neuropathic pain (n=11). Treatment was delivered 5hr/wk for 10wk. Outcomes were assessed pre and post treatment, and at 3mo, 6mo, and 12mo follow-up. **Outcome Measures:** Hospital Anxiety and Depression Scale (HADS).	1. At 12mo, there was no significant change in anxiety scores on the HADS in the treatment group from baseline. 2. However, the treatment group showed systematic decrease in anxiety on the HADS as measured by relative change in position (95% CI) at 12mo.
Kennedy et al., (2003) United Kingdom PCT N=85	**Population:** Mean age=?yr; Gender: males=69, females=16; Level of injury: paraplegia=39, quadriplegia=46; Severity of injury: incomplete=36, complete=49; Mean time post injury=20wk; Anxiety status=symptoms. **Intervention:** Participants received coping effectiveness training (CET, treatment, n=45) or no treatment (control, n=40). CET was delivered in 60-75min sessions for 2x/wk over 3.5wk and involved problem solving, mindfulness, coping, and improving social supports. Outcomes were assessed pre and post treatment, and at a 6wk follow-up. **Outcome Measures:** Beck Depression Inventory (BDI), State Trait Anxiety Inventory (STAI), Coping	1. Post CET, the treatment group showed a significant reduction in STAI scores (p=0.001) compared to controls.

Author Year Country Research Design PEDro Score Total Sample Size	Methods	Outcome
	Strategies Scale (CSS), Self-Perception Scale (SPS).	
King & Kennedy (1999) United Kingdom PCT N=38	**Population:** Mean age=33yr; Gender: males=29, females=9; Level of injury: paraplegia=19, quadriplegia=19; Severity of injury: incomplete=11, complete=27; Mean time post injury=19yr; Anxiety status=symptoms. **Intervention:** Participants received coping effectiveness training (treatment, n=19), while matched controls received standard care (n=19). Treatment was delivered in 60-75min sessions 2x/wk with 6-9 other participants. Sessions included a mixture of didactic presentations, practical exercises and group discussions. Outcomes were assessed pre and post treatment, and at 6wk follow-up. **Outcome Measures:** Beck Depression Inventory (BDI), State Trait Anxiety Inventory (STAI), COPE Inventory.	1. There were significantly greater reductions in HADS- anxiety ($p<0.05$) in the treatment group than in controls.
Craig et al., (1997) Australia PCT N=69	**Population:** Mean age=31yr; Gender: males=57, females=12; Level of injury: paraplegia=34, quadriplegia=35; Severity of injury: incomplete=21, complete=48; Time post injury=acute; Anxiety status=symptoms. **Intervention:** Participants received standard care (control, n=41) or small group cognitive behavioural therapy (CBT, treatment, n=28). CBT was provided for 1.5hr/wk over 10wk and included muscle relaxation, visualization techniques, self-hypnosis, cognitive restructuring, social skills training, and sexuality sessions. Outcomes were assessed pre and post treatment, and at 1yr follow-up. **Outcome Measures:** Beck Depression Inventory (BDI), State Trait Anxiety Inventory (STAI), Rosenberg Self-Esteem scale (RSES).	1. STAI and RSES scores did not improve significantly at 1yr.
Craig et al., (1998) Australia Follow-Up N=58	**Population:** Mean age=31yr; Gender: males=57, females=12; Level of injury: paraplegia=34, quadriplegia=35; Severity of injury: incomplete=21, complete=48; Time post injury=acute; Anxiety status=symptoms. **Intervention:** Participants from Craig et al.,(1997) were assessed at 2yr follow-up. **Outcome Measures:** Beck Depression Inventory (BDI, State Trait Anxiety Inventory (STAI),	1. Those with high STAI scores showed a significant improvement on STAI over time ($p<0.01$).

Discussion

Several studies examined the effect of in person group CBT related programs compared to standard care on improvement of anxiety symptoms for persons with SCI (Craig et al., 1997; P. Kennedy et al., 2003; King & Kennedy, 1999; Li et al., 2019). Three of these studies found significant improvement in anxiety symptoms among those in the CBT group compared to the standard care group (P. Kennedy et al., 2003; King & Kennedy, 1999; Li et al., 2019). Coker et al.,(2019) found no significant effect of group based CBT on anxiety symptoms. Craig et al.,(1997) found no improvement in anxiety symptoms among the participants overall; however,

a subgroup of participants with high levels of anxiety experienced significant improvement in their anxiety symptoms (A. R. Craig et al., 1998).

One study examined the effect of telerehabilitation based CBT for managing anxiety symptoms. Dorstyn et al. (2012), in an RCT, reported small effects of telecounselling in improving anxiety symptoms compared to standard care. Migliorini et al.,(2011) reported improvement in anxiety scores after an online CBT program for persons with SCI. Burke and colleagues (2019) found no significant difference in anxiety symptoms in the intervention group compared to the control group post intervention; however, significant decrease in anxiety symptoms were seen in the treatment group at 3 month follow-up

Four studies examined the effect of CBT program among persons with SCI and chronic pain (Blake et al., 2018; Heutink et al., 2014; Heutink et al., 2012; Norrbrink Budh et al., 2006; Perry et al., 2010) Blake et al., (2018) provided a guided 8 week online CBT program and found significant improvement in anxiety symptoms post intervention. Heutnick et al.,(2012) in an RCT, found significant improvement in anxiety symptoms in the intervention group compared to the wait list control group; these results were maintained at 1 year follow up (Heutink et al., 2014). Perry et al.,(2010) also found a multidisciplinary CBT program resulted in improvements in anxiety over time. However, Norrbrink Budh et al.,(2006) found no significant reduction in anxiety symptoms among those in the CBT group compared to the no treatment group.

Duchnick et al. (2009) evaluated the effectiveness of a CBT training intervention compared to a supportive group program. The study reported significant decrease in anxiety scores among both groups and no group effect.

Dorstyn et al. (2011) compared CBT combined with low dose amitriptyline to a standard care group and found those in the combined CBT and amitriptyline group had a significantly greater reduction in anxiety symptoms compared to the standard care group. However, this was not maintained at follow-up.

Conclusion

There is level 2 evidence from (Craig et al., 1997; A. Craig et al., 1998; A. Craig et al., 1999; A. R. Craig et al., 1998; P. Kennedy et al., 2003; King & Kennedy, 1999), that in person CBT may improve anxiety symptoms compared to standard treatment among those with elevated symptoms.

There is level 1a evidence (Dear et al., 2018; Dorstyn et al., 2011) Miglorini et al.,2011), that telerehabilitation based CBT improves symptoms of anxiety among persons with SCI

There is level 1 evidence (Duchnick et al., 2009; Feng & Li, 2017) that CBT is effective in improving anxiety symptoms post intervention.

Individual based CBT is effective in reducing symptoms of anxiety post SCI; however the results may not be maintained at follow-up.

Cognitive behavioural interventions provided in a group setting appear helpful in reducing post-SCI anxiety among those with elevated symptoms.

Telerehabilitation or online CBT improves symptoms of anxiety post SCI.

4.3.1 Physical Interventions for Anxiety following SCI

4.3.1.1 Physical Activity for Anxiety following SCI

Strategies to encourage health, reduce secondary complications and consequently support positive emotional adjustment following SCI have emerged as a source of increasing research interest. As examples, the following studies review the impact of regular exercise upon various measures of physical health and emotional well-being.

Table 13. Physical Activity for Anxiety following SCI

Author Year Country Research Design PEDro Score Total Sample Size	Methods	Outcome
Akkurt et al., (2017) Turkey RCT PEDro=5 N=33	**Population:** Mean age: Not reported; Median age: Intervention group=33 yr, Control group=37 yr; Gender: males=29, females=4; Time since injury=>1 mo, not specified further; Level of injury: C=1, T=22, L=10; Severity of injury: AIS A=19, B=1, C=10, D=3. **Intervention:** Participants were enrolled in a 12-wk program comparing arm ergometer exercises and general exercises to those that receive only general exercises. **Outcome Measures:** Psychological status (Center for Epidemiologic Studies Depression Scale and Hospital Anxiety and Depression Scale).	2. No intergroup differences were seen in HADS 3. No statistically significant differences over the assessment period between the intervention and control groups in disability levels, QOL, or metabolic syndrome parameters (p=>0.05 for all).
Curtis et al., (2017) Canada RCT Crossover PEDro=6 N=22	**Population:** Yoga group (n=10): Mean age=47.9±19.5 yr; Gender: Not reported; Level of injury: paraplegia=6, tetraplegia=0, ambulatory/unspecified=4; Severity of injury: complete=2, incomplete/disease-related=8. Control group (n=12): Mean age=54.8±10.1 yr; Gender: Not reported; Level of injury: paraplegia=4, tetraplegia=4, ambulatory/unspecified=4; Severity of injury: complete=5, incomplete/disease-related=7. **Intervention:** Participants were randomized to a 6 wk, twice wkly Iyengar yoga group or a 6 wk wait-listed	5. Yoga group had significantly lower scores for the HADS (p<0.05) and significantly higher scores for the SCS (p<0.05) at post-intervention than at baseline. 6. Fixed-factor models showed significantly lower HADS scores postintervention compared to preintervention (p<0.05) with time being the main predictor of HADS scores (p<0.05). 7. There was a trend noticed for FFMQ scores from preintervention to postintervention for total scores (p=0.09) and observing scores (p=0.06).

Author Year Country Research Design PEDro Score Total Sample Size	Methods	Outcome
	control group, then after the first yoga group completed their sessions, the wait-list control group engaged in the yoga protocol. **Outcome Measures:** Pain (brief pain inventory (BPI), pain catastrophizing scale (PCS)), psychological (acceptance and action questionnaire (AAQ), hospital anxiety and depression scale (HADS), general self-efficacy scale (GSES), posttraumatic growth inventory (PTGI-SF), Connor-Davidson resilience scale (CD-RISC), self-compassionate scale (SCS) and mindfulness (five-facet mindfulness questionnaire (FFMQ) measures taken 1-2 wk before and after the program.	2. Postintervention scores for the SCS and FFMQ were both significantly higher than at preintervention ($p>0.05$).
Kennedy et al., (2006) United Kingdom Pre-Post N=35	**Population:** Gender: males=30, females=5; Age: 18-61 yr, Level of injury: paraplegia=20, tetraplegia=15. **Intervention:** Back-Up: 1 wk single or multi-activity course in an integrated, residential environment. Activities include skiing, horseback riding, waterskiing, canoeing, rappelling and gliding. Questionnaires were completed at baseline and end of 1 wk activity courses **Outcome Measures:** Life Satisfaction Questionnaire (LSQ), Hospital Anxiety and Depression Scale (HADS)	1. HADS scores demonstrated significant ($p<0.01$) improvement in anxiety levels over the duration of the course.

Discussion

Three studies evaluated physical activity in improving anxiety symptoms post SCI. Akkurt et al., (2017) found no significant difference in levels of anxiety among those in the arm ergometer plus standard exercise group compared to standard exercise alone. Curtis et al.,(2017) found participation in a yoga program resulted in decreased symptoms of anxiety post intervention. Kennedy et al.,(2006) found increasing level of physical activities such as skiing, horseback riding, resulted in improvement in anxiety levels post intervention.

Conclusion

There is level 1b evidence (K. Curtis et al., 2017) that yoga may decrease symptoms of anxiety post SCI.

There is level 4 evidence (P. Kennedy et al., 2006) that increased physical activity through various outlets may improve anxiety symptoms.

Physical activity may improve anxiety post SCI.

4.3.1.2 Physical Stimulation for Anxiety following SCI

Table 14. Physical Stimulation for Anxiety Following SCI

Author Year Country Research Design PEDro Score Total Sample Size	Methods	Outcome
Tan et al., (2011) USA RCT PEDro=8 $N_{Initial}$=105 N_{Final}=100	**Population:** Mean age=52yr; Gender: males=90, females=15; Level of injury: paraplegia=66, quadriplegia=37, unknown=2; Severity of injury: incomplete=52, complete=42, unknown=11; Mean time post injury=15yr; Anxiety status=symptoms. **Intervention:** Individuals with chronic neuropathic pain were randomized to receive active (treatment, n=46) or sham (control, n=59) cranial electrotherapy stimulation (CES) 1hr/d for 21d. Outcomes were assessed pre and post treatment. **Outcome Measures:** Center for Epidemiologic Studies Depression Scale – Short Form (CES-D-SF), State-Trait Anxiety Inventory – Short Form (STAI-SF).	1. At baseline, the treatment group had significantly poorer scores on STAI-SF ($p<0.05$). 2. There was no significant main effect of time on STAI-SF in either group. 3. There were no significant time x group interactions on STAI-SF.
Soler et al. (2010) Spain RCT PEDro=8 N=39	**Population:** Mean age=45yr; Gender: males=31, females=9; Level of injury: paraplegia=30, quadriplegia=10; Severity of injury: incomplete=8, complete=32; Mean time post injury=9yr; Anxiety status=symptoms. **Intervention:** Individuals with chronic neuropathic pain were randomized to receive transcranial direct current stimulation (tDCS, n=10), visual illusion (VI, n=10), tDCS with VI (n=10), or sham tDCS (placebo, n=10) during 10 sessions over 2wk. Outcomes were assessed pre and post treatment, and 2, 4, and 12wk follow-up. **Outcome Measures:** Numerical Rating Scale for Anxiety (NRS-A).	1. NRS-A score significantly decreased in the tDCS, tDCS+VI, and VI groups ($p<0.019$), but not the placebo group. 2. NRS-A score improvements were only maintained in the tDCS+VI group at all follow-ups ($p<0.04$).
Fregni et al., (2006) USA RCT PEDro=8 $N_{Initial}$=17 N_{Final}=15	**Population:** Mean age=35yr; Gender: males=14, females=3; Level of injury: paraplegic=8, quadriplegic=9; Severity of injury: incomplete=6, complete=11; Mean time post injury=3.5yr; Anxiety status=symptoms. **Intervention:** Individuals with central pain were randomized to receive active (treatment, n=11) or sham (control, n=6) transcranial direct current stimulation (tDCS) 20min/d for 5d. Outcomes were assessed at baseline, 1-5d pre and post treatment, and 16d follow-up. **Outcome Measures:** Beck Depression Inventory (BDI), Visual Analogue Scale-Anxiety (VAS-A).	1. On VAS-A, there was a significant effect of time ($p=0.001$), but not group ($p=0.42$) or time x group ($p=0.99$).

Author Year Country Research Design PEDro Score Total Sample Size	Methods	Outcome
Diego et al., (2002) USA RCT PEDro=8 N=20	**Population:** Mean age=39yr; Gender: males=15, females=5; Level of injury: quadriplegia; Time post injury>1yr; Anxiety status=symptoms. **Intervention:** Participants were randomized to receive massage therapy (treatment, n=10) or perform a home exercise routine (control, n=10) 2x/wk for 5wk. **Outcome Measures:** Center for Epidemiologic Studies Depression Scale (CES-D), State Trait Anxiety Inventory (STAI).	1. The treatment group showed a significantly greater decrease in STAI ($p<0.01$) scores after treatment than controls.

Discussion

In an RCT, Tan et al.,(2011) found no significant difference in anxiety symptoms between participants in the cranial electrotherapy stimulation (CES) compared to sham group. Two studies examined the effect of transcranial direct current stimulation (tDCS) on anxiety after SCI (Fregni et al., 2006; Soler et al., 2010). Soler et al.,(2010) found significant reduction in symtposm among those in the tDCS compared to the sham group. Participants in the TDCS combined with visual illusion group had the greatest decrease in anxiety symptoms. Fregni et al.,(2006) found no significant effects of tDCS on anxiety compared to sham group.

Kennedy et al.,(2006) found participation in an integrated sports activity program resulted in a significant decrease in anxiety symptoms compared to baseline. Diego et al.,(2002) found participants in a massage therapy group experienced significant reduction in anxiety compared to those in the home exercise group.

Conclusion

There is level 2 evidence from 1 RCT, that cranial electrotherapy stimulation may not be effective at reducing symptoms of anxiety after SCI.

There is conflicting evidence from 2 RCTs that transcranial direct current stimulation alone may reduce symptoms of anxiety after SCI.

There is level 2 evidence that combined transcranial direct current stimulation and visual illusion walking may help reduce symptoms of anxiety after SCI

There is level 2 evidence from 1 RCT, that massage may reduce symptoms of anxiety after SCI compared to home exercise.

There is level 4 evidence from 1 pre-post study, that participation in sports activity may reduce symptoms of anxiety after SCI.

Cranial electrotherapy stimulation may not be effective in reducing anxiety symptoms post SCI.

Combined transcranial direct current stimulation and visual illusion walking may reduce symptoms of anxiety post SCI.

Massage may help reduce symptoms of anxiety post SCI.

Participation in sports may reduce symptoms of anxiety post SCI.

4.4.1 Miscellaneous Interventions for Anxiety following SCI

4.4.1.1 Hyperbaric Oxygen for Anxiety following SCI

Table 15. Hyperbaric Oxygen for Anxiety following SCI

Author Year Country Research Design PEDro Score Total Sample Size	Methods	Outcome
Feng et al. (2017) China RCT PEDro=6 N=60	**Population:** HBO group (n=20): Mean age=36.1±5.2 yr; Gender: males=14, females=6; Level of injury: C=7, T=8, L=5; Severity of injury: AIS A=0, B=12, C=5, D=3. Psychotherapy group (n=20): Mean age=34.8±4.7 yr; Gender: males=15, females=5; Level of injury: C=8, T=6, L=6; Severity of injury: AIS A=0, B=10, C=8, D=2. Conventional rehabilitation group (n=20):Mean age=33.1±4.6 yr; Level of injury: C=7, T=9, L=4; Severity of injury: AIS A=0, B=10, C=7, D=3. **Intervention:** Participants were randomly allocated to either a hyperbaric oxygen group (HBO), a psychotherapy group or a conventional rehabilitation group for an 8-wk intervention in which all three groups received routine rehabilitation on top of their intervention. Therapy sessions occurred once a day, 6 days a wk for 8 wk. **Outcome Measures:** Hamilton depression scale (HAMD), Hamilton anxiety scale (HAMA), American spinal injury association score (AISA) and functional independence measure (FIM).	3. HAMD score was significantly lower in both the HBO and psychotherapy groups compared to the control group at the end of 8 wk ($p<0.05$ for both) with no significant difference between HAMD score for HBO and psychotherapy groups from baseline to 8 wk ($p>0.05$). 2. HAMA score was significantly lower for the HBO group than for the control group ($p<0.05$) with no significant difference in HAMA score between the HBO and psychotherapy groups ($p>0.05$).

Discussion

In a randomized controlled trial, Feng et al.,(2017) evaualted the effectiveness of hyperbaric oxygen compared to psychotherapy or standard rehabilitation on anxiety symptoms. The study found significant difference in levels of anxiety among those that received HBO compared to

standard rehabilitation group. No significant difference was seen among HBO and psychotherapy.

Conclusion

There is level 1b evidence that hyperbaric oxygen may improve symptoms of anxiety post SCI

Hyperbaric oxygen may improve symptoms of anxiety post SCI.

4.4.1.2 Education for Anxiety following SCI

Table 16. Education for Anxiety following SCI

Author Year Country Research Design PEDro Score Total Sample Size	Methods	Outcome
Federici et al., (2019) Italy Pre-Post N=11	**Population:** Mean age: males=50.4±7.3 yr, females=41.5±11.26 yr; Gender: males=5, females=6; Time since injury=30.1±9.4 yr; Level of injury: tetraplegia=3, paraplegia=4, no paraplegia/tetraplegia=4; Severity of injury: complete=5, incomplete=2, none=4. **Intervention:** Participants were 4 couples (one with SCI and one without) and 3 singles with SCI who took part in a sexual health psychoeducational intervention in which 4 couples and 3 singles met every two weeks for 12 meetings of a growth group and reported the results of their love lives and persona lives. **Outcome Measures:** Sexual interest and satisfaction scale (SIS), Beck depression inventory – II (BDI-II) and Beck anxiety inventory (BAI).	5. All participants improved significantly on item 5 of the SIS scale "How are your opportunity and your ability to enjoy sexuality yourself?" ($p<0.01$), SIS scale total score ($p<0.05$) and BAI scores ($p<0.05$). 6. No difference was found for SIS scale's general satisfaction after injury, BDI, or BAI ($p>0.05$). 7. Significant effect found on item 5 of the SIS scale "How are your opportunity and your ability to enjoy sexuality yourself?" for both individuals and partners ($p<0.05$ for both).

Discussion

Federici and colleagues (2019) provided participants with a sexual health psychoeducation program over 12 session. The program found no significant improvements in level of anxiety post intervention.

Conclusion

There is level 4 evidence that sexual health may not improve anxiety post SCI

Sexual health education may not improve symptoms of anxiety post SCI.

5.0 Final Comments

This chapter has summarized research highlighting several promising approaches to the management of post-SCI mental health. Additionally, there is also some evidence for the effectiveness of these approaches for related therapeutic targets such as anxiety and self-esteem. However, many of the studies cited note limitations that may introduce caution regarding the generalizability of conclusions to other samples and settings. These have included:

- Small samples sizes and high rates of attrition (due to illness or other factors)
- Possible selection biases
- Ethical concerns that may preclude randomized designs
- Multifaceted interventions complicate understanding of most relevant component(s)
- Impact of social contact in the intervention group often not accounted for in “standard treatment” or “wait list” controls
- Potential impact of adjunctive psychological interventions is unclear
- Use of antidepressant medications not consistently reported
- Lacking long term follow up
- Variability of outcome measures limit comparisons across studies

When leavened with clinical judgment, this research offers preliminary empirical support to guide the practitioner in employing evidenced-based therapeutic strategies. Future investigations, particularly those employing more stringent research designs, will continue to expand the options and confidence of clinical efforts to assist those individuals who have sustained spinal cord injuries. The reader is encouraged to also consider the following topic reviews of depression and SCI (Consortium for Spinal Cord Medicine, 1998; Elliott & Frank, 1996; Elliott & Kennedy, 2004) and also, more generally, a review of SCI rehabilitation (Sipski & Richards, 2006).

6.0 Summary

While not universal, for many persons with spinal cord injury, depression can be a complication that poses a significant impediment to their functioning and adaptation.

Identifying depression can be difficult, but is most likely to develop during the initial year post-injury. Though many will experience a remission of symptoms over time, for others depressive symptoms may persist for many years,

Self-report measures of depression should be viewed as screening tools to alert the clinician to arrange a more thorough evaluation. In addition to affective symptoms, endorsement of somatic symptoms (e.g. sleep disturbance, poor energy and appetite disturbance) during inpatient or outpatient contact merits clinical review to clarify possible mechanisms underlying their emergence.

There is level 2 evidence (from several studies; Table 2) to support the use of small group CBT based treatment packages to decrease depressive symptoms following SCI.

Follow-up findings (1 year post treatment) showed maintenance of affective improvement in four level 2 studies; conversely, evidence from two level 2 studies found that post intervention reduction of depressive symptoms were not sustained at follow up of up to one year.

There is level 1b evidence (from one randomized controlled trial; Schulz et al.,2009) that providing CBT to caregivers and care receivers results in improved depressive symptoms in care receivers.

There is level 4 evidence (from a pre-post study; (Migliorini et al., 2011) that computer based CBT may improve symptoms of depression, anxiety and stress post SCI.

Evidence of the benefits of pharmacotherapy alone and in combination with individual psychotherapy in the treatment of depressive symptoms in individuals with SCI is encouraging, although support is largely from investigations in other populations.

There is level 4 evidence (from one prospective controlled trial and three pre-post studies; Kahan et al.,2006; Kemp et al.,2004; Judd et al.,1989, 1986) indicating the effectiveness of pharmacotherapy combined with cognitive behavioral psychotherapy for treatment of depression in SCI and other chronic disabling conditions.

Regular physical exercise may contribute to a reduction of pain, stress, and depression as well as potentially offering a prophylactic effect on sources of recurrent pain and in preventing a decline in quality of life following SCI.

There is level 1a evidence (from three randomized controlled trials; Hicks et al.,2003; Ginis et al.,2003; Latimer et al.,2005) that exercise based programs reduced subjective pain, stress and resulting depressive symptoms.

There is level 1b evidence (from one randomized controlled trial and one pre-post study; Ginis et al.,2003) (Guest et al., 1997) that exercise reduces depressive symptoms.

There is level 2 evidence (from one cohort study; (Bradley, 1994) that individuals with unrealistic expectations report more depressive symptoms following a functional exercise stimulation exercise program.

There is level 2 evidence (from one randomized controlled trial; Zemper et al.,2003) that a wellness and health promotion program does not significantly decrease intensity of depressive symptoms.

There is level 2 evidence (from one prospective controlled trial; Dunn et al.,2000) that access to medical follow-up for individuals with SCI results in better health, independence, less depression and fewer secondary complications.

There is level 1b evidence (from one randomized controlled trial; Diego et al.,2002) that massage therapy can reduce depressive symptoms.

There is level 1b evidence (from one randomized controlled trial; (Defrin et al., 2007) for the effectiveness of transcutaneous magnetic stimulation in reducing depressive symptoms.

Reference List

Akkurt, H., Karapolat, H. U., Kirazli, Y., & Kose, T. (2017). The effects of upper extremity aerobic exercise in patients with spinal cord injury: a randomized controlled study. *European journal of physical and rehabilitation medicine, 53*(2), 219-227.

Blake, M. J., Trinder, J. A., & Allen, N. B. (2018). Mechanisms underlying the association between insomnia, anxiety, and depression in adolescence: Implications for behavioral sleep interventions. *Clinical psychology review, 63*, 25-40.

Bombardier, C. H., Richards, J. S., Krause, J. S., Tulsky, D., & Tate, D. G. (2004). Symptoms of major depression in people with spinal cord injury: Implications for screening. *Archives of Physical Medicine and Rehabilitation, 85*(11), 1749-1756. doi:10.1016/j.apmr.2004.07.348

Bradley, M. B. (1994). The effect of participating in a functional electrical stimulation exercise program on affect in people with spinal cord injuries. *Archives of Physical Medicine and Rehabilitation, 75*(6), 676-679. doi:10.1016/0003-9993(94)90193-7

Burke, D., Lennon, O., Blake, C., Nolan, M., Barry, S., Smith, E., . . . Fullen, B. M. (2019). An internet-delivered cognitive behavioural therapy pain management programme for spinal cord injury pain: A randomized controlled trial. *Eur J Pain, 23*(7), 1264-1282. doi:10.1002/ejp.1402

Chase, T., Jha, A., Brooks, C. A., & Allshouse, A. (2013). A pilot feasibility study of massage to reduce pain in people with spinal cord injury during acute rehabilitation. *Spinal Cord, 51*(11), 847-851. doi:10.1038/sc.2013.104

Coker, J., Cuthbert, J., Ketchum, J. M., Holicky, R., Huston, T., & Charlifue, S. (2019). Re-inventing yourself after spinal cord injury: a site-specific randomized clinical trial. *Spinal Cord, 57*(4), 282-292. doi:10.1038/s41393-018-0230-8

Consortium for Spinal Cord Medicine. (1998). *Depression Following Spinal Cord Injury: A Clinical Practice Guideline for Primary Care Physicians*. Washington, DC: Paralyzed Veterans of America.

Craig, Hancock, K., Dickson, H., & Chang, E. (1997). Long-term psychological outcomes in spinal cord injured persons: Results of a controlled trial using cognitive behavior therapy. *Archives of Physical Medicine and Rehabilitation, 78*(1), 33-38. doi:10.1016/S0003-9993(97)90006-X

Craig, A., Hancock, K., Chang, E., & Dickson, H. (1998). The effectiveness of group psychological intervention in enhancing perceptions of control following spinal cord injury. *Australian and New Zealand Journal of Psychiatry, 32*(1), 112-118. doi:10.1046/j.1440-1614.1998.00376.x

Craig, A., Hancock, K., & Dickson, H. (1994). A longitudinal investigation into anxiety and depression in the first 2 years following a spinal cord injury. *Spinal Cord, 32*(10), 675-679.

Craig, A., Hancock, K., & Dickson, H. (1999). Improving the long-term adjustment of spinal cord injured persons. *Spinal Cord, 37*(5), 345-350. Retrieved from http://www.scopus.com/inward/record.url?eid=2-s2.0-0033014034&partnerID=40&md5=3b39bbf063ff5769126b887019e572d7

Craig, A. R., Hancock, K., Chang, E., & Dickson, H. (1998). Immunizing against depression and anxiety after spinal cord injury. *Archives of Physical Medicine and Rehabilitation, 79*(4), 375-377.

Crane, D. A., Hoffman, J. M., & Reyes, M. R. (2017). Benefits of an exercise wellness program after spinal cord injury. *J Spinal Cord Med, 40*(2), 154-158. doi:10.1179/2045772315y.0000000038

Curtis, K., Hitzig, S. L., Bechsgaard, G., Stoliker, C., Alton, C., Saunders, N., . . . Katz, J. (2017). Evaluation of a specialized yoga program for persons with a spinal cord injury: a pilot randomized controlled trial. *Journal of pain research, 10*, 999.

Curtis, K. J., Hitzig, S. L., Leong, N., Wicks, C. E., Ditor, D. S., & Katz, J. (2015). Evaluation of a modified yoga program for persons with spinal cord injury. *Therapeutic Recreation Journal, 49*(2), 97.

Cushman, L. A., & Dijkers, M. P. (1990). Depressed mood in spinal cord injured patients: Staff perceptions and patient realities. *Archives of Physical Medicine and Rehabilitation, 71*(3), 191-196. Retrieved from http://www.scopus.com/inward/record.url?eid=2-s2.0-0025274332&partnerID=40&md5=5ef6b844666c96c30503a5bd831ccb9c

Dear, B. F., Nicholson Perry, K., Siddall, P., Middleton, J. W., Johnson, J., Katte, L., . . . Titov, N. (2018). The Pain Course: exploring the feasibility of an internet-delivered pain management programme for adults with spinal cord injury. *Spinal Cord, 56*(10), 931-939. doi:10.1038/s41393-018-0146-3

Defrin, R., Grunhaus, L., Zamir, D., & Zeilig, G. (2007). The Effect of a Series of Repetitive Transcranial Magnetic Stimulations of the Motor Cortex on Central Pain After Spinal Cord Injury. *Archives of Physical Medicine and Rehabilitation, 88*(12), 1574-1580. doi:10.1016/j.apmr.2007.07.025

Diego, M. A., Field, T., Hernandez-Reif, M., Hart, S., Brucker, B., Field, T., & Burman, I. (2002). Spinal cord patients benefit from massage therapy. *International Journal of Neuroscience, 112*(2), 133-142. doi:10.1080/00207450212023

Dorstyn, D., Mathias, J., & Denson, L. (2011). Efficacy of cognitive behavior therapy for the management of psychological outcomes following spinal cord injury: A meta-analysis. *Journal of Health Psychology, 16*(2), 374-391. doi:10.1177/1359105310379063

Dorstyn, D., Mathias, J., Denson, L., & Robertson, M. (2012). Effectiveness of telephone counseling in managing psychological outcomes after spinal cord injury: A preliminary study. *Archives of Physical Medicine and Rehabilitation, 93*(11), 2100-2108. doi:10.1016/j.apmr.2012.06.002

Duchnick, J. J., Letsch, E. A., & Curtiss, G. (2009). Coping Effectiveness Training During Acute Rehabilitation of Spinal Cord Injury/Dysfunction: A Randomized Clinical Trial. *Rehabilitation Psychology, 54*(2), 123-132. doi:10.1037/a0015571

Dunn, M., Love, L., & Ravesloot, C. (2000). Subjective health in spinal cord injury after outpatient healthcare follow-up. *Spinal Cord, 38*(2), 84-91. Retrieved from http://www.scopus.com/inward/record.url?eid=2-s2.0-0034024002&partnerID=40&md5=f893e8d7c0f4a876294cf225607fbda3

Elliott, T. R., & Frank, R. G. (1996). Depression following spinal cord injury. *Archives of Physical Medicine and Rehabilitation, 77*(8), 816-823. doi:10.1016/S0003-9993(96)90263-4

Elliott, T. R., & Kennedy, P. (2004). Treatment of Depression Following Spinal Cord Injury: An Evidence-Based Review. *Rehabilitation Psychology, 49*(2), 134-139. doi:10.1037/0090-5550.49.2.134

Elliott, T. R., & Umlauf, R. L. (1995). Measurement of personality and psychopathology following acquired physical disability. In *Psychological assessment in medical rehabilitation.* (pp. 325-358): American Psychological Association, Washington, DC.

Fann, J. R., Bombardier, C. H., Richards, J. S., Tate, D. G., Wilson, C. S., Temkin, N., & Investigators, P. (2011). Depression after spinal cord injury: comorbidities, mental health service use, and adequacy of treatment. *Archives of Physical Medicine and Rehabilitation, 92*(3), 352-360.

Fann, J. R., Bombardier, C. H., Richards, J. S., Wilson, C. S., Heinemann, A. W., Warren, A. M., . . . Warms, C. (2015). Venlafaxine extended-release for depression following spinal cord injury: a randomized clinical trial. *JAMA psychiatry, 72*(3), 247-258.

Federici, S., Artegiani, F., Pigliautile, M., Antonelli, P., Diotallevi, D., Ritacco, I., & Maschke, R. (2019). Enhancing Psychological Sexual Health of People With Spinal Cord Injury and Their Partners in an Italian Unipolar Spinal Unit: A Pilot Data Study. *Front Psychol, 10*, 754. doi:10.3389/fpsyg.2019.00754

Feng, J.-J., & Li, Y.-H. (2017). Effects of hyperbaric oxygen therapy on depression and anxiety in the patients with incomplete spinal cord injury (a STROBE-compliant article). *Medicine, 96*(29).

Fregni, F., Boggio, P. S., Lima, M. C., Ferreira, M. J., Wagner, T., Rigonatti, S. P., . . . Freedman, S. D. (2006). A sham-controlled, phase II trial of transcranial direct current stimulation for the treatment of central pain in traumatic spinal cord injury. *Pain, 122*(1-2), 197-209.

Guest, R. S., Klose, K. J., Needham-Shropshire, B. M., & Jacobs, P. L. (1997). Evaluation of a training program for persons with SCI paraplegia using the Parastepρ1 ambulation system: Part 4. Effect on physical Self-Concept and depression. *Archives of Physical Medicine and Rehabilitation, 78*(8), 804-807. doi:10.1016/S0003-9993(97)90191-X

Hearn, J. H., & Finlay, K. A. (2018). Internet-delivered mindfulness for people with depression and chronic pain following spinal cord injury: a randomized, controlled feasibility trial. *Spinal Cord, 56*(8), 750-761. doi:10.1038/s41393-018-0090-2

Heutink, M., Post, M. W., Luthart, P., Schuitemaker, M., Slangen, S., Sweers, J., . . . Lindeman, E. (2014). Long-term outcomes of a multidisciplinary cognitive behavioural programme for coping with chronic neuropathic spinal cord injury pain. *J Rehabil Med, 46*(6), 540-545. doi:10.2340/16501977-1798

Heutink, M., Post, M. W. M., Bongers-Janssen, H. M. H., Dijkstra, C. A., Snoek, G. J., Spijkerman, D. C. M., & Lindeman, E. (2012). The CONECSI trial: Results of a randomized controlled trial of a multidisciplinary cognitive behavioral program for coping with chronic neuropathic pain after spinal cord injury. *Pain, 153*(1), 120-128. doi:10.1016/j.pain.2011.09.029

Hicks, A. L., Adams, M. M., Martin Ginis, K., Giangregorio, L., Latimer, A., Phillips, S. M., & McCartney, N. (2005). Long-term body-weight-supported treadmill training and subsequent follow-up in persons with chronic SCI: Effects on functional walking ability and measures of subjective well-being. *Spinal Cord, 43*(5), 291-298. doi:10.1038/sj.sc.3101710

Hicks, A. L., Martin, K. A., Ditor, D. S., Latimer, A. E., Craven, C., Bugaresti, J., & McCartney, N. (2003). Long-term exercise training in persons with spinal cord injury: Effects on strength, arm ergometry performance and psychological well-being. *Spinal Cord, 41*(1), 34-43. doi:10.1038/sj.sc.3101389

Hunt, M., Auriemma, J., & Cashaw, A. C. (2003). Self-report bias and underreporting of depression on the BDI-II. *Journal of personality assessment, 80*(1), 26-30.

Judd, F. K., Burrows, G. D., & Brown, D. J. (1986). Depression following acute spinal cord injury. *Paraplegia, 24*(6), 358-363. Retrieved from http://www.scopus.com/inward/record.url?eid=2-s2.0-0022979677&partnerID=40&md5=465cdb1515ad91e0dba34d541fcf2208

Judd, F. K., Stone, J., Webber, J. E., Brown, D. J., & Burrows, G. D. (1989). Depression following spinal cord injury. A prospective in-patient study. *British Journal of Psychiatry, 154*(MAY), 668-671. Retrieved from http://www.scopus.com/inward/record.url?eid=2-s2.0-0024372925&partnerID=40&md5=bcf2f04efe4bedeecb4d6794735ac170

Julian, L. J. (2011). Measures of anxiety: state-trait anxiety inventory (STAI), Beck anxiety inventory (BAI), and Hospital anxiety and Depression scale-anxiety (HADS-A). *Arthritis care & research, 63*(S11), S467-S472.

Kahan, J. S., Mitchell, J. M., Kemp, B. J., & Adkins, R. H. (2006). The results of a 6-month treatment for depression on symptoms, life satisfaction, and community activities among

individuals aging with a disability. *Rehabilitation Psychology, 51*(1), 13-22. doi:10.1037/0090-5550.51.1.13
Kemp, B. J., Kahan, J. S., Krause, J. S., Adkins, R. H., & Nava, G. (2004). Treatment of major depression in individuals with spinal cord injury. *Journal of Spinal Cord Medicine, 27*(1), 22-28. Retrieved from http://www.scopus.com/inward/record.url?eid=2-s2.0-2942718655&partnerID=40&md5=5206d51b612543890565396b5d3b3a14
Kennedy, P., Duff, J., Evans, M., & Beedie, A. (2003). Coping effectiveness training reduces depression and anxiety following traumatic spinal cord injuries. *British Journal of Clinical Psychology, 42*(1), 41-52. doi:10.1348/014466503762842002
Kennedy, P., & Rogers, B. A. (2000). Anxiety and depression after spinal cord injury: a longitudinal analysis. *Archives of Physical Medicine and Rehabilitation, 81*(7), 932-937.
Kennedy, P., Taylor, N., & Hindson, L. (2006). A pilot investigation of a psychosocial activity course for people with spinal cord injuries. *Psychology, Health and Medicine, 11*(1), 91-99. doi:10.1080/13548500500330494
King, C., & Kennedy, P. (1999). Coping effectiveness training for people with spinal cord injury: Preliminary results of a controlled trial. *British Journal of Clinical Psychology, 38*(1), 5-14. doi:10.1348/014466599162629
Krause, J. S., Bombardier, C., & Carter, R. E. (2008). Assessment of Depressive Symptoms During Inpatient Rehabilitation for Spinal Cord Injury: Is There an Underlying Somatic Factor When Using the PHQ? *Rehabilitation Psychology, 53*(4), 513-520. doi:10.1037/a0013354
Krause, J. S., Kemp, B., & Coker, J. (2000). Depression after spinal cord injury: relation to gender, ethnicity, aging, and socioeconomic indicators. *Arch Phys Med Rehabil, 81*(8), 1099-1109.
Latimer, A. E., Martin Ginis, K. A., Hicks, A. L., & McCartney, N. (2004). An examination of the mechanisms of exercise-induced change in psychological well-being among people with spinal cord injury. *Journal of Rehabilitation Research and Development, 41*(5), 643-651. doi:10.1682/JRRD.2003.04.0043
Le, J., & Dorstyn, D. (2016). Anxiety prevalence following spinal cord injury: a meta-analysis. *Spinal Cord, 54*(8), 570.
Li, Y., Bressington, D., & Chien, W. T. (2019). Pilot evaluation of a coping-oriented supportive program for people with spinal cord injury during inpatient rehabilitation. *Disabil Rehabil, 41*(2), 182-190. doi:10.1080/09638288.2017.1386238
Mackelprang, J. L., Hoffman, J. M., Garbaccio, C., & Bombardier, C. H. (2016). Outcomes and lessons learned from a randomized controlled trial to reduce health care utilization during the first year after spinal cord injury rehabilitation: telephone counseling versus usual care. *Archives of Physical Medicine and Rehabilitation, 97*(10), 1793-1796. e1791.
Martin Ginis, K. A., Latimer, A. E., McKechnie, K., Ditor, D. S., McCartney, N., Hicks, A. L., . . . Craven, B. C. (2003). Using exercise to enhance subjective well-being among people with spinal cord injury: The mediating influences of stress and pain. *Rehabilitation Psychology, 48*(3), 157-164. doi:10.1037/0090-5550.48.3.157
Mehta, S., Orenczuk, S., Hansen, K. T., Aubut, J. A. L., Hitzig, S. L., Legassic, M., & Teasell, R. W. (2011). An Evidence-Based Review of the Effectiveness of Cognitive Behavioral Therapy for Psychosocial Issues Post-Spinal Cord Injury. *Rehabilitation Psychology, 56*(1), 15-25. doi:10.1037/a0022743
Migliorini, C., Sinclair, A., Brown, D., Tonge, B., & New, P. (2016). A randomised control trial of an Internet-based cognitive behaviour treatment for mood disorder in adults with chronic spinal cord injury. *Spinal Cord, 54*(9), 695-701. doi:10.1038/sc.2015.221
Migliorini, C., Tonge, B., & Sinclair, A. (2011). Developing and Piloting ePACT: A flexible psychological treatment for depression in people living with chronic spinal cord injury. *Behaviour Change, 28*(1), 45-54. doi:10.1375/bech.28.1.45

Norrbrink Budh, C., Kowalski, J., & Lundeberg, T. (2006). A comprehensive pain management programme comprising educational, cognitive and behavioural interventions for neuropathic pain following spinal cord injury. *Journal of Rehabilitation Medicine, 38*(3), 172-180. doi:10.1080/16501970500476258

Perry, K. N., Nicholas, M. K., & Middleton, J. W. (2010). Comparison of a pain management program with usual care in a pain management center for people with spinal cord injury-related chronic pain. *Clinical Journal of Pain, 26*(3), 206-216. doi:10.1097/AJP.0b013e3181bff8f3

Richards, J. S., Bombardier, C. H., Wilson, C. S., Chiodo, A. E., Brooks, L., Tate, D. G., . . . McCullumsmith, C. (2015). Efficacy of venlafaxine XR for the treatment of pain in patients with spinal cord injury and major depression: a randomized, controlled trial. *Archives of Physical Medicine and Rehabilitation, 96*(4), 680-689.

Richardson, E. J., & Richards, J. S. (2008). Factor Structure of the PHQ-9 Screen for Depression Across Time Since Injury Among Persons With Spinal Cord Injury. *Rehabilitation Psychology, 53*(2), 243-249. doi:10.1037/0090-5550.53.2.243

Rintala, D. H., Holmes, S. A., Courtade, D., Fiess, R. N., Tastard, L. V., & Loubser, P. G. (2007). Comparison of the effectiveness of amitriptyline and gabapentin on chronic neuropathic pain in persons with spinal cord injury. *Archives of Physical Medicine and Rehabilitation, 88*(12), 1547-1560.

Salinas, F. A., Lugo, L. H., & García, H. I. (2012). Efficacy of early treatment with carbamazepine in prevention of neuropathic pain in patients with spinal cord injury. *American journal of physical medicine & rehabilitation, 91*(12), 1020-1027.

Schulz, R., Czaja, S. J., Lustig, A., Zdaniuk, B., Martire, L. M., & Perdomo, D. (2009). Improving the Quality of Life of Caregivers of Persons With Spinal Cord Injury: A Randomized Controlled Trial. *Rehabilitation Psychology, 54*(1), 1-15. doi:10.1037/a0014932

Siösteen, A., Kreuter, M., Lampic, C., & Persson, L. O. (2005). Patient-staff agreement in the perception of spinal cord lesioned patients problems, emotional well-being, and coping pattern. *Spinal Cord, 43*(3), 179-186. doi:10.1038/sj.sc.3101693

Sipski, M. L., & Richards, J. S. (2006). Spinal cord injury rehabilitation: State of the science. *American Journal of Physical Medicine and Rehabilitation, 85*(4), 310-342. doi:10.1097/01.phm.0000202105.87011.bf

Soler, M. D., Kumru, H., Pelayo, R., Vidal, J., Tormos, J. M., Fregni, F., . . . Pascual-Leone, A. (2010). Effectiveness of transcranial direct current stimulation and visual illusion on neuropathic pain in spinal cord injury. *Brain, 133*(9), 2565-2577. doi:10.1093/brain/awq184

Stolp-Smith, K. A., & Wainberg, M. C. (1999). Antidepressant exacerbation of spasticity. *Archives of Physical Medicine and Rehabilitation, 80*(3), 339-342.

Tan, G., Rintala, D. H., Jensen, M. P., Richards, J. S., Holmes, S. A., Parachuri, R., . . . Price, L. R. (2011). Efficacy of cranial electrotherapy stimulation for neuropathic pain following spinal cord injury: a multi-site randomized controlled trial with a secondary 6-month open-label phase. *The journal of spinal cord medicine, 34*(3), 285-296.

Verwer, J. H., van Leeuwen, C. M., Bolier, L., & Post, M. W. (2016). Feasibility of an online well-being intervention for people with spinal cord injury: a pilot study. *Spinal Cord, 54*(6), 473-477. doi:10.1038/sc.2015.165

Warms, C. A., Belza, B. L., Whitney, J. D., Mitchell, P. H., & Stiens, S. A. (2004). Lifestyle Physical Activity for Individuals with Spinal Cord Injury: A Pilot Study. *American Journal of Health Promotion, 18*(4), 288-291. Retrieved from http://www.scopus.com/inward/record.url?eid=2-s2.0-1542363514&partnerID=40&md5=907c5f9f61d9b3efbb2872abe7b223e6

Williams, R., & Murray, A. (2015). Prevalence of depression after spinal cord injury: a meta-analysis. *Archives of Physical Medicine and Rehabilitation, 96*(1), 133-140.

Zemper, E. D., Tate, D. G., Roller, S., Forchheimer, M., Chiodo, A., Nelson, V. S., & Scelza, W. (2003). Assessment of a Holistic Wellness Program for Persons with Spinal Cord Injury. *American Journal of Physical Medicine and Rehabilitation, 82*(12), 957-968. doi:10.1097/01.PHM.0000098504.78524.E2

Abbreviations

CBT	Cognitive Behavioural Therapy
SCI	Spinal Cord Injury