Depression Following Spinal Cord Injury

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Key Points

Depression is a common consequence of SCI.

Depression post SCI can interfere with function and adaptation.

Cognitive behavioural interventions provided in a group setting appear helpful in reducing post-SCI depression and related difficulties.

The benefits of drug treatment for post-SCI depression are largely extrapolated from studies in non-SCI populations.

Programs to encourage regular exercise, reduce stress, and improve or maintain health appear to have benefits in reducing reports of depressive symptoms in persons with SCI.
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1 Introduction
Psychological adjustment to catastrophic injuries and illnesses is a topic of much interest for practitioners providing clinical rehabilitation services. This chapter attempts to summarize evidence garnered from SCI research that has investigated the treatment of post-SCI depression and depressive symptoms 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 (APA 2005).

Concerns regarding “depression” are commonly reported by SCI survivors, staff, or their families. Indeed, Elliott & 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 emergence of depressive symptoms is not then a surprising outcome of such challenges (Kemp et al. 2004) and some early investigators have described it as an “inevitable” outcome (e.g. Hohmann 1975). Of added concern, rates of suicide average approximately 3 to 5 times that reported in the general population (e.g. DeVivo et al. 1991; Charlifue & Gerhart 1991; Hartkopp et al. 1998) and stand in contrast to the reductions achieved in other preventable causes of death following SCI (e.g. septicemia, respiratory illness, diseases of the urinary system) (Soden et al. 2000). The many consequences of SCI pose multiple stressors for families (e.g., 15% of caregivers reported symptoms consistent with Major Depressive Disorder) (Dreer et al. 2007) and can also result in emotional challenges for rehabilitation staff (North 1999).

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 neurovegetative symptoms of sufficient frequency and severity to negatively impact the functioning of an individual. The Diagnostic and Statistical Manual of Mental Disorders (APA 2000) is a frequently cited classification system for establishing diagnoses of various depressive and other mental disorders. According to the DSM-IV-TR5, depression is not a single entity, but instead represents a range of disorders which are classified according to symptom type, number, severity, duration and functional impact. A diagnosis of Major Depressive Disorder in an adult requires at least a two-week period of five or more symptoms, with at least one either depressed mood or a loss of interest or pleasure in almost all activities. Further symptoms may include:

- Significant weight loss when not dieting or weight gain (e.g., a change of more than 5% of body weight in a month), or decrease or increase in appetite nearly every day.
- Insomnia (inability to sleep) or hypersomnia (sleeping too much) nearly every day.
- Psychomotor agitation or retardation nearly every day.
- Fatigue or loss of energy nearly every day.
- Feelings of worthlessness or excessive or inappropriate guilt nearly every day.
- Diminished ability to think or concentrate, or indecisiveness, nearly every day.
• Recurrent thoughts of death (not just fear of dying), recurrent suicidal ideation without a specific plan, or a suicide attempt or a specific plan for committing suicide.

Symptoms together must result in impairment in functioning (social, occupational or other) and are not due to the direct physiological effects of a substance or medical condition. The classification of affective symptoms continues to be revised with the next edition (DSM-V) anticipated for 2013. As an example, a mixed anxiety and depressive disorder is proposed when anxiety and depression are both present, but neither set of symptoms, considered separately is sufficient to justify a diagnosis (APA, 2010).

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 patients’ reported coping ability and mental health (Siosteen et al. 2005). Similarly, the life satisfaction and well-being of persons in the community with complete tetraplegic injuries (including those who required ventilator support) was shown to be underestimated by health care professionals (Bach & Tilton 1994). Conversely, Kemp and Mosqueda (2004) caution that symptoms of depression can be overlooked or misidentified in people with disabilities.

Various methodological issues have “served to constrain” the study of depression in the SCI population (Elliott & Frank 1996). The use of ambiguous definitions and the unclear or inconsistent use of diagnostic criteria are two of many such challenges. Others issues include a lack of theoretical models, selection biases, limited longitudinal studies and ethical concerns that limit more rigorous experimental designs.

How best should the occurrence of depression be viewed in the process of adjustment to SCI? Anecdotal models of adjustment have incorporated the “clinical lore” that depression was to be universally anticipated soon after injury (Elliott & Kennedy 2004), and demonstrating the individual’s rational acceptance of the permanence of the injury and associated losses (Frank et al. 1985). Taken further, those individuals who do not evidence depression were considered to be in “denial” and potentially vulnerable to a more precarious adjustment (e.g. Siller 1969). Accordingly, it had been also proposed that depression be induced to encourage appropriate grieving (Nemiah 1957). More recently, both the universality and the benefits of depression in the adjustment process have been questioned by numerous investigative findings (e.g. Howell et al. 1981; Judd et al. 1986). Given the many negative outcomes associated with depression post injury (e.g. longer hospitalization, decreased longevity, increased rates of suicide, reduced health, daily functioning, limited community participation) it is likely best viewed as a secondary complication or sequelae rather than an adaptive process facilitating overall emotional adjustment (Consortium for Spinal Cord Medicine 1998).

Kemp et al. (2004) noted that depression is not simply a necessary consequence of sustaining a SCI – not all who sustain a SCI become depressed. Tirch et al. (1999) studied depressive symptoms in 11 pairs of monozygotic twins where one of the pair had sustained a SCI. The SCI and non-SCI co-twins did not differ significantly in their self-reports, lending additional support to the view that SCI does not inevitably lead to increased depression. Further, there is little relationship between depression and the level of SCI or the completeness of the lesion (Kemp et al. 2004). As an example, Hall et al. (1999) sampled 82 individuals with C1-4 quadriplegia between 14 and 24 years post injury, and these individuals reported their self-esteem and quality of life to be high – with 95% feeling they were “glad to be alive”.

2
Depression post-SCI can be a function of difficulties coping with the multiple environmental, social and health-related problems that follow. If depression is not inevitable following SCI, then it is noteworthy that depression is related to modifiable factors that play a role in its development and maintenance (Kemp et al. 2004). In a summary of the adjustment literature, Elliott and Rivera (2003) described a model determining psychological well being and physical health post-SCI. The components include demographics, injury characteristics, preinjury behaviours and psychopathology, personality factors, social/environmental factors and styles of appraisals. The authors highlight how the consequences of physical disability exist within a larger context and that changes in public and health policies can dramatically impact post-injury quality of life.

2 Prevalence of Depression Post-SCI

Estimates of the prevalence of depression are affected by the nature of the measures used, how depression is defined, aging characteristics of the samples studied and when symptoms are assessed post-injury (Elliott & Frank 1996). The common research practice of employing self-report measures is both convenient and cost-effective. However, the resulting prevalence rates may reflect subjective anxiety and overall distress rather than symptoms specific to depression, per se. In clinical practice, self-report measures may serve to alert the clinician to the need for additional evaluation and can aid in monitoring symptom severity over time. For reviews of depression and other psychosocial measures frequently used in spinal injury research and practice see Vahle et al. (2000), Richards et al. (2006), SCIRE chapter 25. and Sakakibara et al. (2009).

In their review, Bombardier et al. (2004) found rates of major depression or probable major depression following SCI vary widely across studies and can range from 7% to 31% of persons, with estimates of major depressive disorder typically reported in 15%-23% of individuals. In a recent survey of 568 adult traumatic SCI inpatient rehabilitation clients, approximately 22% met self reported symptoms consistent with major depressive disorder on average less than two months post injury (Krause, Bombardier and Carter, 2008). Bombardier et al. (2004) surveyed 849 SCI outpatients at one-year post injury and found 11.4% met criteria for MDD. 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 et al. 2008).

With up to 25% of men and 47% of women affected (Consortium for Spinal Cord Medicine 1998) a recent case-matched comparison found an absence of gender differences in probable major depression and symptom severity (Kalpakjian and Albright 2006). In an Italian sample averaging 6 years post-SCI, Scivoletto et al. (1997) found 16% reported significant symptoms of depression and 13% anxiety. Migliorini et al. (2008) employed an Australian sample who averaged 19 years post-SCI, 37% were identified as depressed, 30% suffered anxiety, 25% experienced significant stress and 8.4% reported post-traumatic stress disorder. Of note, approximately 60% of individuals with one probable diagnosis were likely to suffer at least one other comorbid condition highlighting the potential complexity of mental health issues.

In a 6-year follow-up study of 233 Albertans with SCI, 28.9% were treated for depression following their traumatic SCIs, with approximately 59% of these individuals beginning treatment during their initial hospitalization (both acute and rehabilitation admissions). An additional 10%
of people were treated during the remainder of the first year. This exceeded depression treatment rates reported in able-bodied controls of approximately 11% (Dryden et al. 2004), with those at highest risk reporting permanent neurological deficit, a preinjury history of depression, or substance abuse (Dryden et al. 2005). Kennedy and Rogers (2000) reported that anxiety, depression and hopelessness gradually increased beginning at week 30 post injury and continued until discharge from rehabilitation (week 48). At that point 60% of SCI clients scored above a clinical cut-off for depression (i.e. Beck Depression Inventory). Krause et al. 2008 suggested that depressive symptoms may not peak during inpatient rehabilitation and it may take additional time for the “low point of emotional adaptation to appear”.

In a cross sectional study, Richardson and Richards (2008) found that rates of clinically significant depressive symptoms (PHQ-9 scores >10) were reported by approximately 21%, 18%, 12% and 12% of SCI survivors surveyed at 1, 5, 15 and 25 years post injury, suggesting rates tended to decrease with time since injury. Data obtained in earlier studies also suggested that in newly injured persons who met criteria for major and minor depression, many remit within 3 months of onset (Kishi et al. 1994) and that the frequency of reported problems decreases over the first year (Richards 1986). In a longitudinal analysis, Pollard and Kennedy (2007) found a substantial relationship between reported depressive symptoms at 3 months and approximately a decade post injury, with 38% and 35% of SCI survivors surveyed meeting a criterion for moderate depression at these times. Hoffman et al. (2008) followed 411 SCI model system participants and found approximately 20% of at 1 year post injury and 18% at year 5 post-injury reported symptoms consistent with major depression. Further, approximately a third of those reporting scores suggestive of moderate depression at year 1 experienced remission, while approximately 9% were newly depressed at year 5. The authors summarized that the natural history of depression post SCI was variable over time with some showing improvement while others exhibited emotional decline.

It has been questioned whether, despite its reported prevalence, efforts to improve the detection and treatment of depression in individuals with SCI has improved (Bombardier et al. 2004). In an editorial comment, Faber (2005) expressed concern that given possible underestimates, about half of all persons hospitalized for traumatic SCI may benefit from treatment for depression. Similarly, while a substantial percentage of their SCI clinic sample reported symptoms suggestive of major depression, Kemp and Krause (1999) found that none were receiving treatment (psychotherapy or medications). In a review of American veterans with spinal cord injuries and disabilities, Smith et al. (2007) concluded that many may not be receiving adequate treatment for depression and the authors encouraged more aggressive screening and treatment.

As health problems can produce pain, fatigue, sleep disturbances, physical sensations and digestive troubles, the overlap of somatic symptoms can pose diagnostic challenges. Krause, Bombardier and Carter (2008) noted that on average, nearly a third of a large sample of SCI adult inpatient rehabilitation clients cited sleep, energy and appetite changes, while symptoms of persistent depressed mood and anhedonia were reported by approximately 10% and 15% of the sample, respectively. In a large outpatient sample, 80% of SCI survivors with probable MDD reported symptoms of depressed mood, anhedonia, feelings of failure, disturbed sleep and decreased energy (Bombardier et al. 2004). 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 (Richardson and Richards, 2008; Krause et al. 2008).
Conclusions

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.

Depression is a common consequence of SCI.

Depression post SCI can interfere with function and adaptation.

3 Interventions for Treatment of Depression following SCI

The American Psychological Association (APA 2005) states that evidence-based practice involves the integration of the best of existing research with clinical expertise and the reality of the patient’s needs and wishes. Practical and ethical concerns may limit the availability of SCI research evidence.

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 patients and obtaining treatment and appropriate control groups requires the participation of multiple sites. Also, ethical concerns over providing the best possible care to all SCI patients are obvious, so that withholding aspects of treatment in order to establish control conditions is no longer acceptable (e.g. Kahan et al. 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.

Typical SCI interventions to encourage post-SCI adjustment are often multi-faceted; thereby posing difficulties in identifying which combination of components can offer optimal care for any particular patient. Further, psychosocial interventions cannot be independent of other aspects of care (e.g. medical, rehabilitation). Wait-list control conditions do not address personal contact, attention and perceived support available in intervention conditions. In addition, many pre-morbid psychological and historical influences are very difficult to determine.

As the nature of SCI studies make it more difficult to limit certain biases, the validity and generalizability of the findings is less clear. Despite these challenges, researchers have made invaluable clinical contributions using smaller groups, non-randomized control groups, or controls chosen from historical data. However, in summarizing the limited research currently
available, Elliott and Kennedy (2004) suggested “we have many untested assumptions regarding the available treatments for depression among persons with SCI” and have questioned whether the current “glaring lack of intervention data” reflects a lack of interest on the part of consumers, researchers and funding agencies with regard to various interventions for treatment of depression in those with SCI. Kahan et al. (2006) stressed that treatment of depression in people aging with a disability is “far from being developed”, noting a “massive dearth” of research of any kind for individuals with disabilities.

3.1 Psychological Interventions

3.1.2 Cognitive Behavioural Therapy

In the SCI population, the application of cognitive behavioural therapy (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 et al. 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 SCI individuals. 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 1 Cognitive Behavioural Therapy Group Interventions

<table>
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<tr>
<th>Author Year</th>
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<th>Score</th>
<th>Research Design</th>
<th>Sample Size</th>
<th>Methods</th>
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<tbody>
<tr>
<td>Duchnick et al. 2009</td>
<td>PEDro=4</td>
<td>RCT</td>
<td>N=41</td>
<td>N(CET)=21; C(SGT)=20</td>
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**Population:** CET: Mean age=50.8yrs; Gender: males=95%; Level of injury: tetraplegia=40%; Severity of injury: AIS A=30%; B=30%; C=5%; D=35%; SGT: Mean age=54.6yrs; 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).

**Treatment:** Participants were randomly allocated into either the CET (Coping effectiveness training) group or the SGT (Supportive group therapy) group. Each inpatient group met once weekly for 60 minutes. 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:** CESD, SAI

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<th>Outcomes</th>
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<td>1. No baseline differences were found.</td>
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<td>2. Mood change was not affected by treatment condition.</td>
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<td>3. Significant decrease in anxiety (measured with SAI) and depression (CESD) was seen at discharge (p&lt;0.05). However, both anxiety (p&lt;0.001) and depression (p&lt;0.05) increased significantly between discharge and follow-up (3 months)</td>
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<td>Author Year</td>
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<td>Craig et al. 1997</td>
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<td>King &amp; Kennedy 1999</td>
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<td>Norrbrink Budh et al. 2006</td>
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<td>Dorstyn et al. 2010</td>
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<td>Kennedy et al. 2003</td>
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<tr>
<td>Author Year Country Score Research Design Sample Size</td>
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| Downs & Black score=19 Australia cohort Initial N=85; Final N=85 | Depression status=mild (BDI=15) **Treatment:** Consisted of 7, 60-75 minutes sessions that ran twice a week 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:** BDI, STAI, CSS, SPS, and 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. | likely to have a complete injury and to have been injured longer than the control group (p<0.01).  
2. Intervention group tended to use active and religious coping strategies (p<0.05).  
3. Intervention group tended to use drugs/alcohol less frequently (adjusted for unequal variance p<0.05).  
Post-intervention comparison of groups:  
1. Overall the intervention was successful in decreasing both depression and anxiety.  
2. Mood: Depression scores decreased for the intervention group following the intervention (p=0.001).  
3. Anxiety: Decreased for the intervention group following the intervention (p=0.001).  
4. Coping: Alcohol use was significantly lower for the intervention group, (p=0.003).  
5. Self Perception Scale: Intervention group only-ideal self scores had significantly greater scores than either how they would see themselves without injury (p<0.05) or "as I am" on all items (p<0.001). |
| Craig et al. 1999 Australia Downs & Black score=18 Case Control Initial N=58; Final N=58 | **Population:** SCI: Age = 16-73 yrs; Gender: males = 57, females = 12; Severity of injury: complete = 68%-71%; Chronicity = acute. Depression status=mixed group **Treatment:** 10 weeks in small groups. Each session lasted from 1.5 to 2 hours replacing normal rehab therapy. Patients underwent cognitive behaviour 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.  
4. 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). | 1. No pre-treatment differences between the treatment and the control groups on LCB.  
2. No significant differences were found between groups overall for locus of control as a result of treatment.  
3. No significant differences occurred across time for LCB. |
| Craig et al. 1998b Australia Downs & Black score=17 Prospective Controlled Trial (longitudinal) (Continuation of Craig et al. 1997) | **Population:** SCI: Age = 16-73 yrs; Gender: males = 57, females = 12; Severity of injury: complete = 68%-71%. Chronicity = acute. Depression status=mixed **Treatment:** 10 week program. Small groups (4-5 per group), for 1.5 hours per week. Major aim was to provide | 1. No pre-treatment differences between the treatment and the control groups on LCB.  
2. No significant differences were found between groups overall for locus of control as a result of treatment.  
3. No significant differences occurred across time for LCB. |
<table>
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<th>Sample Size</th>
<th>Methods</th>
<th>Outcomes</th>
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<td>Initial N=69; Final N=58</td>
<td>cognitive and behavioural skills to cope with the psychological and social difficulties encountered upon entering the community. Cognitive behavioural therapy included muscle relaxation, visualization techniques, self-hypnosis and cognitive restructuring, social skills and assertiveness training, and sexuality sessions. <strong>Outcome Measures:</strong> LCB, BDI.</td>
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<td>4. No significant interactions present between group and time.</td>
<td>5. A repeated measure MANOVA was completed on participants (n=26) who scored higher than 33 on the LCB.</td>
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<td>6. Significant differences were noted between the two groups (p&lt;0.05).</td>
<td>7. Across time there was a significant reduction in LCB scores across time. (p&lt;0.05).</td>
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<td>8. Post hoc Scheffe tests indicated post-treatment scores to be lower than pre-treatment scores (p&lt;0.01).</td>
<td>9. A significant association was found between depressive mood and locus of control post-therapy, 1 year later and 2 years later.</td>
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<td>10. For the control group locus of control was mildly associated with depressive mood and for the treatment group's locus of control was not significantly associated with depressive mood at anytime.</td>
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**Note:** BDI=Beck Depression Inventory; CESD=Center for Epidemiologic Studies Depression Scale; CSS=Coping Strategies Scale; DASS-21=Depression, Anxiety and Stress Scales 21; FIM=Functional Impairment Measure; HADS=Hospital Anxiety and Depression Scale; LCB=Locus of Control Behaviour Scale; STAI=State Trait Anxiety Inventory; SPS=Self Perception Scale; SSQ=Social Support Questionnaire;

**Discussion**

In Australia, Craig et al. reported several studies (1997, 1998a, 1998b, 1999) employing a 10 week CBT-based group treatment format involving newly injured SCI rehabilitation inpatients with permanent injuries. They developed a CBT-based treatment protocol implemented by a psychologist and an occupational therapist. Treatment groups consisted of 4-5 individuals and sessions approximated 1.5 to 2 hours weekly. A matched control group of SCI patients received traditional rehabilitation services. Measures of depression, anxiety and self-esteem were completed when individuals were no longer immobilized in bed, after conclusion of therapy (3 months post injury) and at one year post injury. Prior to treatment, the treatment group reported greater self-esteem than did control, but did not differ on other outcome measures. Anxiety did not change over time. Both treatment and control groups reported fewer symptoms of depression at 12 months post injury. Taking into account pretreatment group differences in self-esteem, there was no significant improvement over time for either group. Given that neither group had high levels of depressive mood before treatment, a further analysis of those with elevated scores on depression revealed that the mean score for the treatment group (n= 10) showed improvement after treatment and further gains one year later. Controls (n = 12) who were moderately to severely depressed initially remained at these levels over the year. Patients with initially high levels of anxiety (in either condition) showed decreases in symptoms over the year, with a trend for those in the treatment group to improve more so than did those in the control group. CBT did not significantly impact upon self-esteem in individuals with recent onset SCI. The authors conclude that clinicians servicing SCI rehabilitation wards should evaluate individuals soon after admission to identify those with high levels of depression and/or anxiety.
and then recommend CBT. Further, not all persons with SCI are depressed, anxious or low in self-esteem, and may not require intervention.

In a follow-up report, Craig et al. (1998a) surveyed a subset of the SCI CBT treatment group participants and SCI controls (noted above) at 24 months post injury. Group differences were not significant for measures of depression and anxiety. At 1 and 2 years post injury, subjects were less depressed but levels of anxiety were essentially unchanged. For those subjects with elevated depressive symptoms prior to treatment, levels of depression over the long term were lower for the treatment than the control group. Differences over time were also noted, with the short-term improvements in the depressive symptoms of the treatment group maintained over the two-year period. In contrast, controls did not show improvement in the short term and were only slightly improved after 1 to 2 years. Interestingly, the authors report that none of the treatment group had sought further treatment for depression between the 12 and 24-month period. Both groups became less anxious over time. The small number of subjects precluded identification of significance, but an inspection of the data revealed that the treatment group lowered their elevated anxiety scores to within the normal range at two years, while the control subjects’ scores averaged approximately one standard deviation above general population norms. The authors conclude that not all individuals with recent onset SCI require specialized psychological intervention. For those with elevated levels of reported depression and anxiety, these symptoms hypothetically could return to normal levels in the absence of intervention. However, such improvements could require a protracted period and result in both increased health costs and a diminished quality of life. This study further suggests the merits of screening and ongoing benefits of an intervention program.

In a related study, Craig et al. (1998b) used the Locus of Control Behaviour Scale (LCB) to assess subjects’ perceptions that circumstances were within or beyond their control. No treatment differences were found when comparing SCI CBT group participants and controls over a two-year post injury period. Both groups averaged scores in the range suggestive of a more internal rather than external orientation. When subjects with scores suggestive of an external locus of control scores were identified (9 treatment subjects and 16 controls), the treatment group showed a significant reduction in externality over time while controls did not. The finding supports the conclusion that CBT was effective for those in the treatment group who perceived living with a SCI (and related concerns) to be out of their control. Associations of locus of control scores and depressive mood (Beck Depression Inventory) almost all reached significance for the control group when assessed pre treatment, post treatment, and at one and two year intervals. In contrast, no associations were evident between LCB scores and reports of depressive symptoms in SCI treatment subjects, even for those who were external in their perceptions prior to participation in the CBT group. The authors speculated that CBT “positively interfered in the determination of depressive mood”. While there may be a substantial group at risk for developing psychological difficulties following spinal cord injury, the majority did not show problematic levels of externality and helplessness. As such, the authors concluded that CBT for all SCI survivors is costly and unnecessary.

Craig et al. (1999) continued a long term (2 years post injury) assessment of persons with SCI who previously participated in a non-randomized longitudinal controlled trial of CBT during their inpatient admission to a rehabilitation ward (1991-1992). These responses were compared with those of control subjects who received only traditional rehabilitation services during their hospital stay. Treatment subjects indicated 15% fewer hospital readmissions, 25% less drug use and much more often reported a positive adjustment than did controls. Of concern, approximately 40% of controls frequently used drugs. Forty three percent of controls reported that they had not adjusted well, while only one treatment subject held a similar view. Neither
group reported the occurrence of suicide over the two years. Self-reports of adjustment were negatively correlated with Beck Depression Scale scores. The groups did not differ in the frequency of relationship breakups, with the majority of those married at the time of injury remaining so at two years. Further, about half who were unmarried had formed new relationships. The findings again are seen as suggesting benefits of CBT group treatment in encouraging positive adjustment following SCI.

Two studies conducted at the National Spinal Cord Injuries Centre (NSCIC) in the UK investigated group Coping Effectiveness Training (CET). CET includes CBT, didactic, and practical elements. The first (King & Kennedy 1999) was a pilot study of CET, and the second (Kennedy et al. 2003) continued the work with additional subjects and measures. Both studies used matched historic controls from the NSCIC database, although there did remain some significant pre-intervention differences between groups. Results suggest that their intervention package produced a number of positive changes, including less depression and anxiety, less use of alcohol, and more positive self-perception. Participants said that they found the sharing of views and experiences and reviews of “real life” scenarios to be most valuable aspects of the group.

In an RCT conducted by Duchnick et al. (2010), 41 individuals from an inpatient rehabilitation hospital were randomized into either a CET group or supportive group therapy (SGT). The SGT group received minimal structure and skills training compared to the CET group. Both groups were led by two doctoral level psychologists with SCI rehabilitation experience. Sessions were 1 hour each week for the duration of their inpatient rehabilitation (8-12 weeks). No significant difference was initially evident at baseline in the Center of Epidemiologic Studies of Depression Scale (CESD) and State Anxiety Inventory (SAI) scores between the two groups. Both groups showed significant improvement in depression and anxiety scores at discharge (p<0.05). However, both depression and anxiety scores at 3 month follow-up had returned to initial levels.

In a level 2 study Norrbrink Budh et al. (2006) investigated the effects of an outpatient comprehensive pain management program for individuals with SCI and neuropathic pain. The intervention group received education, CBT, relaxation and body awareness training totaling five hours weekly over a 10 week period while matched controls received no treatment. At 1 year follow up, the sign test showed no significant change in depression and anxiety levels (Hospital Anxiety and Depression Scale (HADS)) in the treatment group from baseline. However, the treatment group showed a systematic decrease in anxiety and depression as measured by relative change in position (95% confidence interval) at one year follow up. Depression also decreased systematically in the treatment group compared to the control group at 1 year follow up; however, the sign test showed no significant change. Reported levels of pain intensity, health related quality of life and life satisfaction did not differ between groups or over time.

Dorstyn et al. 2010 conducted a small prospective controlled trial to examine the effectiveness of CBT on the mood of individuals with SCI. In the study, those with subclinical DASS-21 scores were assigned to the control group, while patients with moderate to severe scores were offered individual CBT treatment for a range of 7 to 22 sessions (30-60mins each). Low dose amitriptyline was prescribed for a subset of the treatment group to help manage their distress while several control participants were similarly medicated for neuropathic pain. The authors found mood had no effect on the functional outcome of patients at admission or discharge. In the treatment group, the total DASS-21 scores did not change significantly over the treatment course; however depression, anxiety and stress subscale scores were found to decrease significantly post intervention and then increase significantly at 3 month follow-up post discharge. The control groups’ remained stable over the period of investigation. At 3 month
follow-up, 78% of individuals in the treatment group met clinical levels of “caseness” on 1 or more clinical subscales while only 1 individual in the control group met these criteria.

Conclusion

**There is level 2 evidence from 6 studies to supporting the use of small group CBT based treatment packages to decrease depressive symptoms following SCI.**

*Follow up findings (up to 1 year post treatment) showed maintenance of affective improvement in 4 level 2 studies. Conversely, evidence from 2 level 2 studies found that post intervention reduction of depressive symptoms were not sustained at follow up (up to 1 year).*

*One level 2 study did not identify significant improvement in depressive symptoms.*

Cognitive behavioural interventions provided in a group setting appear helpful in reducing post-SCI depression and related difficulties.

### 3.2 Combined Psychotherapy and Pharmacotherapy for Treatment of Depression in SCI

Several case series studies have reported positive results using pharmacotherapy for depression in SCI individuals (e.g. amitriptyline (Kim et al. 1977; Fullerton et al. 1981) mianserin and nomifensine (Judd et al. 1986); tetracyclic and tricyclic antidepressants (Judd et al. 1989)). Though reports of depressive symptoms were infrequent, Osteraker and Levi (2005) note that 25% and 30% of an inpatient Swedish SCI rehabilitation sample were prescribed antidepressants at admission and discharge, respectively. In an electronic record review of over 17,000 veterans with “SCI and disorders” who sought inpatient or outpatient services during a three year period, Smith et al. (2007) noted that 22% had at least one encounter with a diagnosis of “depression”. The majority of these depressed individuals (72%) received antidepressant therapies, typically a selective serotonin reuptake inhibitor (SSRI) - most often sertraline. In a Canadian centre, approximately a third of traumatic spinal cord injured individuals and approximately 40% of those with non-traumatic spinal cord injuries received antidepressant therapy during inpatient rehabilitation in addition to other counseling and therapeutic services (2006-2008) (J. Conlon, personal communication, December 16, 2008).

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 2 Combined Psychotherapy and Pharmacotherapy for Treatment of Depression in SCI

<table>
<thead>
<tr>
<th>Author Year Country</th>
<th>Country Score Research Design Sample Size</th>
<th>Methods</th>
<th>Population: SCI; Age = 20-74 yrs; Gender: males = 32; females = 11; Time since injury = 5-37 yrs; 28 treated for</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kemp et al. 2004 USA</td>
<td>Downs &amp; Black score=20</td>
<td></td>
<td>1. Depression Outcomes: A decrease was observed in depression scores from 0-24wks in the treatment group</td>
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<tr>
<td>Author Year Country Score Research Design Sample Size</td>
<td>Methods</td>
<td>Outcomes</td>
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<tr>
<td>Pre-post Initial N=43; Final N=28</td>
<td>depression, 15 acted as quasi-controls. Depression status=major depression using OAHMQ <strong>Treatment</strong>: 6 months of individual outpatient treatment. 2 components-psychotherapy and medication were offered to all. Cognitive behavior therapy began once a week for the first 2 months then was reduced to twice a month. All were prescribed an antidepressant based upon their needs and physician’s decision. Average number of therapy session completed was 14 out of 17 (range from 6 to 17). <strong>Outcome Measures</strong>: OAHMQ, HDRS, Community activities checklist, LSS</td>
<td>2. Paired t-tests indicated a 24% decline in depression scores from 0-8wks (time 1=15.7, time 2=11.9, p&lt;0.001) and from 8-24wks (6.7) (p&lt;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. Community activities: There was a significant increase in community activities from 0-24wks of treatment (p&lt;0.001). 5. T-tests showed a 40% increase in activities from 0-8wks (time 1=11.1, time 2=15.5, p&lt;0.001). 6. A further increase was noted between 8 and 24 weeks (time 2=15.5, time 3=22.3, p&lt;0.001). The correlation between the change in # of depressive symptoms and the change in the # of community activities was high (-0.81, p&lt;0.001). 7. Life satisfaction: While a significant overall effect was observed for life satisfaction scores (p&lt;0.001), significant differences in life satisfaction were noted only between 8 and 24 weeks (time 2=23.5, time 3=28.4, p&lt;0.001). 8. Non-treatment group: Scores on the depression measure did not change significantly over time.</td>
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<td>Kahan et al, 2006 USA Downs &amp; Black score=18 NonRCT Overall N=76; SCI N=41</td>
<td><strong>Population</strong>: Treatment group: SCI = 28, Other conditions = 26; Mean age = 51.4 yrs Gender: males = 52.7%, females = 46.3%; Time since injury = 26.2 yrs; Quasi control group: SCI = 13, Other = 9; Mean age = 44.2 yrs; Gender: males = 45.5%, females = 54.4%; Time since injury = 18.8 yrs. Depression status=major depression evaluated using OAHMQ. <strong>Treatment</strong>: Treatment group received a mixture of outpatient cognitive behavioral psychotherapy and antidepressant medication (individualized), for 30 weeks. <strong>Outcome Measures</strong>: OAHMQ-depression; LSS, The Community Activities Checklist - community activity involvement. Treatment group: @ baseline (T1), 10 weeks (T2) &amp; 30 weeks (T3). Control group: @ 2 points (routine medical visits) spanning 2 years.</td>
<td>1. Depression Outcomes: Depression rate of the treatment group was improved between all time points (p&lt;0.001). 2. At baseline, OAHMQ scores in 53/54 treatment subjects classified as &quot;experiencing major depression&quot; and 1/54 had &quot;significant depression symptoms&quot;. By T3, 41 subjects classification had improved and 13 remained the same with an improved OAHMQ score (ps&lt;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&lt;0.001). Mean depression scores reduced by 50% &amp; 12% in treatment &amp; control groups, respectively. 4. Community activity scores: Improved</td>
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<tr>
<td>Author Year</td>
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<td>Score</td>
<td>Research Design</td>
<td>Sample Size</td>
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<tr>
<td>Judd et al. 1989</td>
<td>USA</td>
<td>Downs &amp; Black score=13</td>
<td>Pre-Post</td>
<td>N=14</td>
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<tr>
<td>Judd et al. 1986</td>
<td>USA</td>
<td>Downs &amp; Black score=11</td>
<td>Pre-Post</td>
<td>N=9</td>
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Note: BDI=Becks Depression Inventory; HDRS=Hamilton Depression Rating Scale; LSS=Life Satisfaction Scale; OAHMQ=Older Adult Health & Mood Questionnaire

Discussion

Kemp et al. (2004) used a pre-post treatment design to assure access to services and avoid ethical concerns that might arise in a randomized trial. A total of 43 community living adult SCI survivors were identified as depressed using the Older Adult Health and Mood Questionnaire and confirmed by clinical interview. Citing distance problems, 15 subjects subsequently declined participation but served as a “quasi-control” group. The 28 remaining subjects began a combined 6-month trial of antidepressant medications and individual cognitive behavioural psychotherapy. The participants were somewhat older but did not differ from non-participants in terms of level of injury, gender, or race/ethnicity. Medications employed included SSRI and tricyclic antidepressants. A clinical psychologist provided psychotherapy that included education regarding the signs, symptoms and consequences of depression, cognitive restructuring, problem solving and encouraging greater community involvement (average of 14 sessions). During the treatment trial, four subjects discontinued their medications, one discontinued psychotherapy and three developed medical complications. When these eight subjects were excluded, all of the remaining 20 subjects improved, no longer meeting criteria scores for major depression (12 appeared mildly depressed and eight appeared non-depressed). Their participation in community activities doubled over the 24 weeks, while life satisfaction showed improvement, primarily during the final 16 weeks of the program. The
average depression score for non-treated subjects did not change significantly over a 24-month follow-up period and suggests that untreated depression can become a chronic disorder.

In a subsequent investigation combining a reanalysis of previous SCI participant data (40 of 43 were presented in above study) and an expansion to include 36 community dwellers with polio, cerebral palsy, stroke, rheumatoid arthritis, or other impairments, Kahan et al. (2006) explored the effects of a 6 month program of CBT and antidepressant therapy in an adult sample reporting major depression (54 received treatment and 22 no treatment). A pre-post treatment design was employed to assure access to services and avoid ethical concerns that might arise in a randomized trial. A clinical psychologist provided psychotherapy that included education regarding the signs, symptoms and consequences of depression, cognitive restructuring, problem solving and encouraging greater community involvement (average of 8 sessions; ranging from 4 to 17). Most commonly used were SSRIs (18 participants) while 7 took tricyclic antidepressants.

On average, depression scores declined 50% over the course of treatment. Seventy six percent improved to a less severe category of depression, while 24% remained unchanged. Of those who improved, approximately 30% no longer were classified as depressed. Of those who reported continued major depression despite treatment, they showed a decrease in the number of symptoms reported. In contrast, approximately a third of the no-treatment group improved, over half remained unchanged, and the remainder became worse. While the small sample sizes precluded statistical analysis, a pattern of improvement across disability subgroups was apparent. Benefits of treatment were significant by approximately 10 weeks.

The authors conclude that community dwelling individuals who have long term impairments and report depression can derive benefit from a combined intervention, with six months of treatment suggested as a minimum standard. The frequency of participation in community activities was specifically targeted and doubled over the course of treatment. Further, reported life satisfaction also improved, despite persistent dissatisfaction in physical status.

Furthermore, in two pre-post studies, Judd et al. (1989; 1986) also found improvement in inpatients’ BDI and anxiety levels post pharmacological and psychological treatment. Fullerton et al. (1981) interviewed 30 SCI rehabilitation patients using the SADS and identified nine as depressed. While three initiated treatment with amitriptyline, one patient responded and side effects required the intervention be discontinued in the remaining two. Depression was reported to have remitted in all patients at time of discharge (average 12 weeks).

**Conclusion**

*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 four non-RCT studies indicating the effectiveness of pharmacotherapy combined with cognitive behavioral psychotherapy for treatment of depression in SCI and other chronic disabling conditions.*

The benefits of drug treatment for post-SCI depression are largely extrapolated from studies in non-SCI populations.
3.3 Exercise 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 3 Exercise for Depression following SCI

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<thead>
<tr>
<th>Author Year</th>
<th>Country</th>
<th>Score</th>
<th>Research Design</th>
<th>Sample Size</th>
<th>Methods</th>
<th>Outcomes</th>
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<tr>
<td>Hicks et al. 2003</td>
<td>Canada</td>
<td>PEDro=8</td>
<td>RCT</td>
<td>Initial N=43; Final N=32</td>
<td>Population: Age = 19-65 yrs; Gender: both; Time since injury = 1-24 yrs. Treatment: Experimental group participated in a progressive exercise training program twice weekly for 9 mths on alternative day’s 90-120 mins 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 cardiovascular function, muscle strength &amp; quality of life.</td>
<td>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&lt;0.01) and a better Q of L (p&lt;0.05). 2. Performance on the 3-stage arm crank protocol was different paraplegics and tetraplegics. (p&lt;0.05). 3. No changes in HR and BP between groups or after 9 months of training. 4. Arm crank protocol was different between tetraplegia and paraplegia. Training induced increases occurred in all subjects in the experimental group. 5. No significant differences in heart rate response over the 9 mths. 6. Significant group x lesion x time interactions were found in stages 2 (p=0.006) and stage 3 (p=0.02), indicating the tetraplegics had the greatest decrease in heart rate. 7. Changes in muscle strength: Experimental group showed changes in muscle strength over the 9 mth period. The control group did not show any significant changes.</td>
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<td>Latimer et al. 2002; PEDro=6</td>
<td>RCT</td>
<td>N=20</td>
<td>Population: Age: 19-65 years; Gender males = 5, females = 16; Time since injury = 1 year. Treatment: A nine-month program of twice-weekly small group exercise sessions of 60-90 minutes duration incorporating stretching, arm ergometry, and resistance exercise under the supervision of volunteers at a university health promotion centre. Control subjects were instructed to continue with their normal activities and were requested to refrain from starting a regular exercise routine during the length of the study. Monthly health information sessions were discontinued.</td>
<td>1. Path A (treatment-exercise to outcome) (ΔR2=0.19, p&lt;0.05), and path B (exercise and perceived pain) (ΔR2=0.28, p&lt;0.01) and stress (ΔR2=0.23, p&lt;0.01) were significant. 2. Path C (mediator-outcome) revealed that depression was predicted by stress (β=0.49, p=0.02) but not by perceived pain (β=0.29, p=2.25).</td>
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<td>Author Year Country</td>
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<td><strong>Ginis et al. 2003</strong>&lt;br&gt;Canada</td>
<td>PEDro=6&lt;br&gt;RCT</td>
<td>Initial N=34; Final N=34</td>
<td><strong>Population</strong>: Age: 19-65 years; Gender males = 5; females = 16; Time since injury = 10.4 yrs.&lt;br&gt;<strong>Treatment</strong>: Those in the exercise sessions of stretching, arm ergometry, and resistance exercise under the non-exercise group were asked to continue their usual activities and were asked not to exercise regularly.&lt;br&gt;<strong>Outcome Measures</strong>: Pain perception (SF-36); Symptom self efficacy and perceived control (2 core items from the Beliefs Scale a modified version of the Arthritis Beliefs Scale); PSS.</td>
<td>3. Path A (treatment-exercise to outcome) (ΔR²=0.19, p&lt;0.05), and path B (exercise and perceived pain) (ΔR²=0.28, p&lt;0.01) and stress (ΔR²=0.23, p&lt;0.01) were significant. 1. Path C (mediator-outcome) revealed that depression was predicted by stress (β=0.49, p=0.02) but not by perceived pain (β=0.29, p=2.25).</td>
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<td><strong>Latimer et al. 2005</strong>&lt;br&gt;Canada</td>
<td>PEDro=3&lt;br&gt;RCT</td>
<td>N=23</td>
<td><strong>Population</strong>: Intervention group - Tetraplegic=7, Paraplegic=6; Gender: m=9, f=4; Mean age=37.54 yrs; Mean time post injury= 9.23 yrs. Control group - Tetraplegic=4, Paraplegic=6; Gender: m=5, f=5; Mean age=43.30 yrs; Mean time post injury= 15.70 yrs&lt;br&gt;<strong>Treatment</strong>: Intervention group: A 6 mos exercise program 2x/wk in small groups (avg 3-5 people), run by student volunteer personal trainers. Control group: Asked to continue daily activities normally and not begin an exercise routine within 6 mos.&lt;br&gt;<strong>Outcome Measures</strong>: PSS, CESD, PQOL</td>
<td>1. At baseline, increased stress levels were related to increased depression rates (p&lt;0.05). At 6 mos, the exercise group's stress and depression association had decreased but remained significant in the control group (p&lt;0.05). 2. At baseline, increased stress levels were associated to decreased perceived QOL (p&lt;0.05). At 3 &amp; 6 mos, the exercise group's stress and QOL association decreased, but remained high across all time points for the control group (p&lt;0.05). 3. Exercise was found to buffer the effects of stress on QOL &amp; depression.</td>
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<td><strong>Hicks et al. 2005</strong>&lt;br&gt;Canada</td>
<td>Downs &amp; Black score=18&lt;br&gt;Pre-Post&lt;br&gt;N=14</td>
<td><strong>Population</strong>: Chronic incomplete SCI: N=14; Tetraplegic=11, Paraplegic=3; Gender: m=11, f=3; Age range= 20-53 yrs; Mean time post injury=7.4 yrs; ASIA: B=2, C=12&lt;br&gt;<strong>Treatment</strong>: Body weight supported treadmill training (BWSTT -robotic) – up to 45 min, 3x/week, 144 sessions (12 months).&lt;br&gt;<strong>Outcome Measures</strong>: CESD</td>
<td>1. Increased life satisfaction &amp; increased physical function satisfaction (p&lt;0.05), after BWSTT. 2. No change in depression or perceived health.</td>
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<td><strong>Warms et al. 2004</strong>&lt;br&gt;USA</td>
<td>Downs &amp; Black score=14&lt;br&gt;Pre-Post&lt;br&gt;N=16</td>
<td><strong>Population</strong>: Gender: m=13, f=3; Mean age= 43.2 yrs; Mean time post injury=14.4 yrs.&lt;br&gt;<strong>Treatment</strong>: “Be Active in Life” program: included educational materials (2 pamphlets, 2 handouts), a home visit with a nurse (90 min. scripted motivational interview, goal and personal action plan establishment), and follow up calls at day 4, 7, 11 &amp; 28 (approx. 8 min each). Program lasted</td>
<td>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. Self-rated abilities: no change. Exercise self-efficacy: ↑ (p&lt;0.01). 3. Self-rated health: increased (p=0.04). 1. Depression: no change.</td>
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<td>Author Year</td>
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<td>Guest et al. 1997</td>
<td>USA</td>
<td>Downs &amp; Black score=13</td>
<td>Pre-Post N=15</td>
<td>Traumatic complete paraplegics; N=15; Gender: m=12, f=3; Mean age= 28.8 yrs; Mean time post injury=3.8 yrs.</td>
<td>Electr       ally stimulated walking program - 32-sessions, using the Parastep® FNS ambulation system.</td>
<td>1. Physical Self-Concept: decreased after electrically stimulated walking (p&lt;0.05). Those with lower baseline score had the most significant improvements. 2. Depression: decreased after electrically stimulated walking (p&lt;0.05).</td>
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<td>Kennedy et al. 2006</td>
<td>UK</td>
<td>Downs &amp; Black score=11</td>
<td>Pre-Post N=35</td>
<td>Gender: males=30, females=5; Age: 18-61 yrs. Level of injury: paraplegia = 20, tetraplegia=15.</td>
<td>Back-Up: a 1-week 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.</td>
<td>1. Significant improvement (p=0.016) in life satisfaction and satisfaction with leisure (p=0.007) 2. Anxiety levels were significantly reduced (p&lt;0.01). 3. No overall improvement in perceived manageability however some difference (p=0.016) post test was observed for engage “in what happens around me” indicating some use of Perceived Manageability strategy. 4. Self-efficacy scores improved post test (p=0.012). 3. HADS scores demonstrated significant (p&lt;0.01) improvement in anxiety levels over the duration of the course.</td>
</tr>
<tr>
<td>Bradley et al. 1994</td>
<td>USA</td>
<td>Downs &amp; Black score=10</td>
<td>Cohort N=37</td>
<td>Gender: males=24, females=13; Mean age=32.03 yrs; Level of injury: tetraplegic=12, paraplegic=25; Mean time post injury=6.51 yrs</td>
<td>Intervention group: 3 mos. FES exercise program; Control group: no intervention.</td>
<td>1. Increased in depression &amp; hostility for those who had unrealistic expectations of the FES program (p&lt;0.01 &amp; p&lt;0.05, respectively). 2. No other significant effects were found.</td>
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</table>

Note: BP=blood pressure; BWTT=Body Weight Treadmill Training; CESD=Centre of Epidemiological Studies Depression Scale; FES=Functional Electrical Stimulation; HADS=Hospital Anxiety and Depression Scale; HR=heart rate; LSQ=Life Satisfaction Questionnaire; MAACLR=Multiple Affect Adjective Check List; PQOL=Perceived Quality of Life; PSS=Perceived Stress Scale; QoL=Quality of Life; SF-36=Short Form 36 Item Health Survey; SRHS=Self Rated Health Scale; TSCS=Tennessee Self-Concept Scale

Discussion

In a series of Canadian studies, Ginis et al. (2003), Hicks et al. (2003) and Latimer et al. (2004; 2005) reported RCT investigations of sedentary community dwelling SCI adult volunteers who participated in 3, and later 9 month trials of twice weekly, 60-90 minute sessions of stretching, aerobic arm ergometry and resistance exercises or a “wait” control condition who were asked to continue usual activities and refrain from beginning an exercise program. Among other findings, Exercisers reported less stress, fewer depressive symptoms and greater satisfaction with physical functioning than did controls. While the average frequency of depressive symptoms in the intervention group did not vary substantively over the 9 months (and remained below clinically significant levels), depressive symptoms in the control group increased and the
average exceeded levels considered “at risk” for clinical depression. The authors suggested the benefits of exercise as offering a prophylactic or stabilizing effect on pain – perhaps reducing the propensity for flare-ups, and the potential benefits of targeting sources of recurrent pain (i.e. shoulder pain). Consistent with the Chronic Pain Process Model, a series of regression analyses the nine-month data revealed that changes in perceived pain mediated changes in stress, and the change in stress mediated a change in reported depression. It was recommended that clinicians prescribe exercise as a therapeutic modality for improving and maintaining well-being among people with SCI.

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 one year of exercise; however, there was no change in reports of depressive symptoms.

Two studies (Bradley et al. 1994; Guest et al. 1997), examined the effects of an electrically stimulated walking program on SCI individuals. Bradley et al. (1994) in a cohort study, reported a significant increase in depression in participants with “unrealistic” expectations of their program. In contrast, Guest et al. (1997) using a pre-post design, 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 (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

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 1 evidence from 2 RCTs and level 2 evidence from 1 RCT that exercise based programs reduced subjective pain, stress and resulting depressive symptoms.

There is level 1 evidence from 1 RCT and level 4 evidence from 1 pre-post study that exercise reduces depressive symptoms.

Level 2 evidence from 1 cohort study of individuals with unrealistic expectations report more depressive symptoms following an FES exercise program.

Programs to encourage regular exercise, reduce stress, and improve or maintain health appear to have benefits in reducing reports of depressive symptoms in persons with SCI.

3.4 Other Treatments Depression following SCI

Table 4 Other Treatments for Depression following SCI
<table>
<thead>
<tr>
<th>Author Year</th>
<th>Country</th>
<th>Score</th>
<th>Research Design</th>
<th>Sample Size</th>
<th>Methods</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Downs &amp; Black 2000</td>
<td>USA</td>
<td>Non-RCT</td>
<td>N=371;</td>
<td>Population: Gender: mixed group with more males; Mean time since injury = 18.44 yrs.</td>
<td>Treatment: Follow-up after initial rehabilitation was completed addressing more males; Mean time since injury = 18.44 yrs.</td>
<td>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</td>
</tr>
<tr>
<td>Zemper et al. 2003</td>
<td>USA</td>
<td>PEDro=4</td>
<td>RCT</td>
<td>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 yrs; Gender: males = 30; females = 13; Level of injury: paraplegia = 42%; tetraplegia = 39%; ambulatory = 3%; Mean time since injury = 14 yrs; Marital status: single = 28%, married = 23%, divorced = 8%. Treatment: A series of six 4 hr workshop sessions held over a 3 month 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 months following the workshops. Controls participated in pre/post assessment but received no intervention. Outcome Measures: HPLP II, SCS, SAHP, PADS</td>
<td>1. The intervention group showed statistically significant improvement after intervention in several areas as compared to the control group: SAHP: (p&lt;0.05) HPLP-II: (p&lt;0.001). Nutrition HPLP-II subscale: improvement in nutritional awareness and behaviour (p &lt;0.05) Stress HPLP-II subscale: increased use of stress management techniques and decreases in perceived stress (p = .001). 2. SOS: fewer and less serious secondary conditions (p&lt;0.001) Depression was less though did not reach significance. 3. Physical Activity – (self-reported on various scales of the HPLP-II): Increased reported physical activity and improved physical fitness (p = 0.001). 4. However there was no improvement in either measured Physical Activity PADS or physical fitness measures.</td>
<td></td>
</tr>
<tr>
<td>Defrin et al. 2007</td>
<td>Israel</td>
<td>PEDro=10</td>
<td>RCT</td>
<td>N=12</td>
<td>Population: Mean age = 54 yrs; Gender: males = 7, females = 4. Treatment: Patients were randomly placed into two groups: real or sham 10 daily motor rTMS treatments (500 trains at 5 Hz for 10s; total of 5000 pulses at intensity of 115% of motor threshold) over a 2 week 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: BDI</td>
<td>1. Real and sham TMS groups showed a significant decrease in BDI values following the treatment period in comparison to pretreatment BDI values (P&lt;0.01). 2. This reduction was maintained by both groups at follow-up (4.5 weeks) (P&lt;0.01). 3. Only patients 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&lt;0.05).</td>
</tr>
<tr>
<td>Diego et al. 2002</td>
<td>USA</td>
<td>PEDro=8</td>
<td>RCT</td>
<td>N=20</td>
<td>Population: Mean age = 39 yrs; Gender: males = 15, females = 5; Level of injury: tetraplegia; Time since injury = minimum 1 year. Treatment: One group received a 40 min massage 2 x per week for 5 weeks by a massage therapist while the other was taught an exercise routine that they performed 2 x per week for 5 wks on their own. Outcome Measures: STAI, CESD.</td>
<td>1. Interaction effect on STAI scores (p&lt;0.01). 2. Massage group had significantly lower anxiety scores immediately after treatment on the first (p&lt;.001) and the last (p&lt;0.01) sessions. 3. CES-D scores obtained on first day vs. last day assessment by group. Repeated measures ANOVA showed a group by day interaction effect (p&lt;0.05). 4. t-tests revealed greater decrease in CES-D depression scores for the massage therapy group (p&lt;0.05).</td>
</tr>
</tbody>
</table>
**Methods**

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:** The Secondary Surveillance Instrument (SCSI) and the Check Your Health Questionnaire (CHY) (rating the “absence” of depression).

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.

**Note:** BDI=Beck Depression Index; CESD=Centre for Epidemiological Studies Depression Scale; HPLP II=Health Promoting Lifestyle Profile II; MBI=Modified Barthel Index; PADS=Physical Activities with Disabilities Scale; SAHP=Self rated Abilities for Health Practices Scale; SCS=Secondary Conditions Scale; SRHS=Self Rated Health Scale; STAI=State Anxiety Inventory

**Discussion**

Dunn et al. (2000) reported that veterans approaching 20 years post SCI with access to medical follow-up through a specialty comprehensive outpatient program reported better health, independence, and less depression than a demographically similar (civilian) group without access to follow-up care. Neither group reported “depression” with sufficient frequency to earn it a top ten ranking from a list of 40 possible complications. However, those without access to medical follow-up who did endorse depression considered it of sufficient intensity to rank it among the ten most severe problems. While the types of secondary complications were similar, these were less frequent and less severe in those receiving health care. Noting a variety of methodological concerns that limit conclusions and generalizability, the authors reported that their findings were consistent with those in other studies (involving SCI and other patient groups).

Zemper et al. (2003) examined a holistic wellness program for SCI patients. The intervention in this RCT study involved six group workshop sessions focused upon lifestyle management (including sexual health and stress management), physical activity, nutrition, and preventing secondary complications. It also included individual coaching sessions and follow-up phone calls. Assessments were completed at three times: prior to the series, two weeks following completion and four months later. Results of this study pointed to improvements in awareness and behavior in areas of health practices, nutrition, and stress. Also secondary conditions were fewer and less serious. Reports of depression intensity decreased but did not reach significance. Self-reports indicated improvements in physical activity, while more objective tests showed no improvement in physical fitness.

With a university clinic group of 20 outpatients with quadriplegic injuries, Diego et al. (2002) compared the effects of a 5-week massage therapy program to those of an independently performed exercise routine conducted over a similar period. Subjects were stratified according to range of motion and then assigned to either of the two treatment groups. While both groups averaged pretreatment depression scores approaching the clinically depressed range, only the massage therapy group showed a decrease in reported post treatment depression symptoms. The massage therapy group also reported lower anxiety immediately after treatment on the first and last days of the protocol. The authors suggested that the significant gains in upper limb...
muscle strength and wrist range of motion demonstrated by the massage therapy group may have contributed to their reported reduction in subjective distress.

One RCT (Defrin et al. 2007) evaluated the effectiveness of transmagnetic stimulation (TMS) 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.

Conclusion

There is level 2 evidence from 1 RCT suggesting a wellness and health promotion program did not significantly decrease intensity of depressive symptoms.

In 1 non-RCT, access to medical follow-up for individuals with SCI found reports of better health, independence, less depression and fewer secondary complications.

There is level 1 evidence that massage therapy can reduce depressive symptoms

There level 1 evidence for the effectiveness of TMS in reducing depressive symptoms.

Several non-traditional approaches to SCI appear to offer improved health practices and a reduction in reported secondary conditions including depression.

4 Final Comments

This chapter has summarized research highlighting several promising approaches to the management of post-SCI depression. Additionally, their 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 recent state of the science review of SCI rehabilitation (Sipski & Richards 2006).

5 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 some individuals, 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 6 studies supporting the use of small group CBT based treatment packages to decrease depressive symptoms following SCI.

Follow up findings (up to 1 year post treatment) showed maintenance of affective improvement in 4 level 2 studies. Conversely, evidence from 2 level 2 studies found that post intervention reduction of depressive symptoms were not sustained at follow up (up to 1 year).

One level 2 study did not identify significant improvement in depressive symptoms.

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

There is level 4 evidence from four non-RCT studies 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 1 evidence from 2 RCTs and level 2 evidence from 1 RCT that exercise based programs reduced subjective pain, stress and resulting depressive symptoms.

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