

Table 9. Physical Activity for Depression following SCI

<b>Author Year</b> <b>Country</b> <b>Research</b> <b>Design PEDro</b> <b>Score Total</b> <b>Sample Size</b>	<b>Methods</b>	<b>Outcome</b>
<a href="#">Bombardier et al. (2021)</a> United States RCT Pedro=5 Level 2 NInitial=15 NFinal=14	<p><b>Population:</b> <i>Intervention group</i> (exercise; n=7): Mean age=56±13yr; Gender: males=5, females=2; Mean time post injury= 12±8yr; Level of injury: Cervical=0, thoracic=6, lumbar=1; Severity of injury: AIS A=7; Depression status: mild as assessed by PHQ-9.</p> <p><i>Control group</i> (Usual care; n=8): Mean age=49±13yr; Gender: males=6, females=2; Mean time post injury= 18±16yr; Level of injury: Cervical=2, thoracic=6, lumbar=0; Severity of injury: AIS</p>	<ol style="list-style-type: none"> <li>1. The exercise intervention group showed a significant difference in improving probable major depression (PHQ-9 score&gt;10) when compared to the control group that only completed their usual care (p=.049).</li> <li>2. No significant between-group differences were observed in improvement of mild depression symptoms post-intervention (p&gt;.05).</li> </ol>

	<p>A=8; Depression status=mild as assessed by PHQ-9.</p> <p><b>Intervention:</b> Participants were randomly assigned to the physical activity intervention group and the control group. The intervention group received a multi-component intervention consisting of 16-session physical activity counseling curriculum delivered by a psychologist via telephone calls over 24wk and a free home exercise toolkit. The control group received a letter informing them of their test results and randomization status. They were advised to seek medical care to make lifestyle changes such as diet and exercise to address their cardiometabolic disease or risk factors. Outcome measures were assessed at baseline and at 6mo post- intervention.</p> <p><b>Outcome Measures:</b> Peak oxygen consumption (VO2 peak), Body mass index (BMI), waist circumference, Insulin sensitivity (ISI), Physical Activity Recall Assessment for Spinal Cord Injury (PARA-SCI), Brief pain inventory intensity and interference scales, Wheelchair User Shoulder Pain index, Patient Health Questionnaire-9 (PHQ-9), World Health Organization Quality of Life Scale (WHOQOL-BRIEF), and participant confidence.</p>	
<p><a href="#">Akkurt et al.</a> (2017) Turkey</p>	<p><b>Population:</b> Mean age: Not reported; Median age: Intervention group=33 yr, Control group=37 yr;</p>	<p>1. No intergroup differences were seen in HADS and CES-D.</p>

<p>RCT PEDro=5 N=33</p>	<p>Gender: males=29, females=4; Time since injury=&gt;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.</p> <p><b>Intervention:</b> Participants were enrolled in a 12-wk program comparing arm ergometer exercises and general exercises to those that receive only general exercises.</p> <p><b>Outcome Measures:</b> Psychological status (Center for Epidemiologic Studies Depression Scale and Hospital Anxiety and Depression Scale).</p>	<p>2. No statistically significant differences over the assessment period between the intervention and control groups in disability levels, QOL, or metabolic syndrome parameters (<math>p &gt; 0.05</math> for all).</p>
<p><a href="#">Curtis et al.</a> (2017) Canada RCT Crossover PEDro=6 N=22</p>	<p><b>Population:</b> 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.</p> <p>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.</p> <p><b>Intervention:</b> 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.</p> <p><b>Outcome Measures:</b> Pain</p>	<ol style="list-style-type: none"> <li>1. Yoga group had significantly lower scores for the HADS (<math>p &lt; 0.05</math>) and significantly higher scores for the SCS (<math>p &lt; 0.05</math>) at post-intervention than at baseline.</li> <li>2. Fixed-factor models showed significantly lower HADS scores postintervention compared to preintervention (<math>p &lt; 0.05</math>) with time being the main predictor of HADS scores (<math>p &lt; 0.05</math>).</li> <li>3. There was a trend noticed for FFMQ scores from preintervention to postintervention for total scores (<math>p = 0.09</math>) and observing scores (<math>p = 0.06</math>).</li> <li>4. Postintervention scores for the SCS and FFMQ were both significantly higher than at preintervention (<math>p &gt; 0.05</math>).</li> </ol>

	<p>(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.</p>	
<p><a href="#">Latimer et al.</a> (2004) Canada RCT PEDro=1 N=23</p>	<p><b>Population:</b> 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</p> <p><b>Intervention:</b> 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.</p> <p><b>Outcome Measures:</b></p>	<ol style="list-style-type: none"> <li>1. At baseline, ↑ stress levels were related to ↑ depression rates (<math>p &lt; 0.05</math>). At 6 mos, the exercise group's stress and depression association had ↓ but remained significant in the control group (<math>p &lt; 0.05</math>).</li> <li>2. At baseline, ↑ stress levels were associated to ↓ perceived QOL (<math>p &lt; 0.05</math>). At 3 and 6 mo the exercise group's stress and QOL association ↓ but remained ↑ across all time points for the control group (<math>p &lt; 0.05</math>).</li> <li>3. Exercise was found to buffer the effects of stress on QOL and depression.</li> </ol>

	<p>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</p>	
<p><a href="#">Hicks et al.</a>, (2003) Canada RCT PEDro=8 NInitial=43 NFinal=32</p>	<p><b>Population:</b> Age=19-65 yr; Gender: both; Time since injury=1-24 yr. <b>Intervention:</b> 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, the workload increased. Some resistance training took place. <b>Outcome Measures:</b> Changes in depression, cardiovascular function, muscle strength and quality of life.</p>	<p>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).</p>

<p><a href="#">Martin Ginis et al.</a> (2003) Canada RCT PEDro=6 NInitial=3 4 NFinal=34</p>	<p><b>Population:</b> Mean age=8.6 yr; Gender: 23 males, 11 females; Mean time post-injury: 10.4 yr.</p> <p><b>Intervention:</b> Intervention group: 5 min of stretching, 15 -30 min of aerobic arm ergometry exercise &amp; 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</p> <p><b>Outcome Measures:</b> Perceived Quality of Life (PQOL); Center for Epidemiologic Studies Depression Scale (CES-D).</p>	<p>1. After 3 months, when compared to controls, exercisers had:</p> <ul style="list-style-type: none"> <li>- ↑ QOL (p=0.007)</li> <li>- ↓ depression (p=0.02)</li> </ul>
<p><a href="#">Diego et al.</a>, (2002) USA RCT PEDro=8 N=20</p>	<p><b>Population:</b> Mean age=39 yr; Gender: males=15, females=5; Level of injury: tetraplegia; Time since injury=&gt;1 yr.</p> <p><b>Intervention:</b> 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.</p> <p><b>Outcome Measures:</b> State Trait Anxiety Inventory (STAI), Center for Epidemiologic Studies Depression Scale (CES-D).</p>	<p>1. 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&lt;0.05).</p> <p>2. T-tests revealed greater decrease in CES-D depression scores for the massage therapy group (p&lt;0.05).</p>

<p><a href="#">Mehta et al.</a> (2021)</p> <p>Canada</p> <p>Pre-Post</p> <p>Level 4</p> <p>N=4</p>	<p><b>Population:</b> <i>Intervention group</i> (n=4): Mean Age=56.4yr; females=9; Mean time post injury=20.25yr; Level of injury: cervical=1, thoracic=3; Severity of injury: incomplete=3, complete=1; Depression status=symptoms.</p> <p><b>Intervention:</b> Online group-based physical activity (PA) program, consisting physical exercises and peer social interaction, 60min/session, 2x/wk for 6wk. The Physical Activity Group Environment Questionnaire and Participant Satisfaction Survey (PSS) were assessed post-intervention. The Quality of Life in Neurological Disorders short-form (NeuroQoL- SF) was assessed at baseline, post- intervention, and at 3mo follow-up.</p> <p><b>Outcome Measures:</b> Participant Satisfaction Survey (PSS), participant recruitment, engagement, and retention, Physical Activity Group Environment Questionnaire, Quality of Life in Neurological Disorders short-form (NeuroQoL- SF).</p>	<ol style="list-style-type: none"> <li>1. Moderate to large effect sizes were seen on measures of depression (d = 0.67), anxiety (d=2.39), and satisfaction with social roles and activities (d=0.43) from baseline to post-intervention.</li> <li>2. The improvements were maintained just for anxiety (d=2.02) and satisfaction with social roles and activities scores (d=0.52) at 3mo follow-up.</li> <li>3. Participants were highly satisfied with the program in general, the instructions, the instructor's knowledge, effectiveness, and content of the program.</li> <li>4. Participants were moderately- highly satisfied with the accessibility of the program.</li> <li>5. Participants were mixed satisfied with the technology of the program.</li> </ol>
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<p><a href="#">Crane et al.</a>, (2017) USA Pre-Post NInitial=89 NFinal=45</p>	<p><b>Population:</b> 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.</p> <p><b>Intervention:</b> Participants engaged in a 3-mo physical therapy group exercise class, twice per wk.</p> <p><b>Outcome Measures:</b> Pre-post intervention interviews about exercise frequency and intensity, perceived health, pain, mood, sleep, and television watching habits.</p>	<ol style="list-style-type: none"> <li>1. Significant improvement in state of health as well as a significant increase in days per week of moderate to vigorous activity (<math>p &lt; 0.05</math> for both).</li> <li>2. Total Patient Health Questionnaire-2 depression scores were significantly lower at post-intervention assessment (<math>p &lt; 0.05</math>).</li> <li>3. Participant comments from the interviews reinforced the program's positive influence on their health.</li> </ol>
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<p><a href="#">Curtis et al.</a>, (2015)</p> <p>Canada Pre-Post N=11</p>	<p><b>Population:</b> 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.</p> <p><b>Intervention:</b> Participants took part in an 8-wk modified yoga program with assessments taken at baseline and post-intervention.</p> <p><b>Outcome Measures:</b> 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.</p>	<ol style="list-style-type: none"> <li>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 (<math>p &lt; 0.05</math>).</li> <li>2. No significant differences between baseline and exit scores for any measure (<math>p &gt; 0.05</math>).</li> </ol>
<p><a href="#">Kennedy et al.</a> (2006) United Kingdom</p>	<p><b>Population:</b> Gender: males=30, females=5; Age: 18-61 yr, Level of</p>	<ol style="list-style-type: none"> <li>1. HADS scores demonstrated significant (<math>p &lt; 0.01</math>)</li> </ol>

<p>Pre-Post N=35</p>	<p>injury: paraplegia=20, tetraplegia=15.</p> <p><b>Intervention:</b> 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</p> <p><b>Outcome Measures:</b> Life Satisfaction Questionnaire (LSQ), Hospital Anxiety and Depression Scale (HADS)</p>	<p>improvement in anxiety levels over the duration of the course.</p>
<p><a href="#">Hicks et al.</a> (2005) Canada Pre-Post N=14</p>	<p><b>Population:</b> 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.</p> <p><b>Intervention:</b> Body weight supported treadmill training (BWSTT) -robotic – up to 45 min, 3x/week, 144 sessions (12 mo).</p> <p><b>Outcome Measures:</b> Center for Epidemiologic Studies Depression Scale (CES-D)</p>	<ol style="list-style-type: none"> <li>1. Increased life satisfaction and increased physical function satisfaction (p&lt;0.05), after BWSTT.</li> <li>2. No change in depression or perceived health.</li> </ol>
<p><a href="#">Warmset al.</a> (2004) USA Pre-Post N=16</p>	<p><b>Population:</b> Gender: males=13, females=3; Mean age=43.2 yr; Mean time post injury=14.4 yr.</p> <p><b>Intervention:</b> “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</p>	<ol style="list-style-type: none"> <li>1. Physical activity: Counts/day increased in 60% of subjects and self-reported activity increased in 69% of subjects, but neither were not significant.</li> <li>2. Depression: no change.</li> </ol>

	<p>at day 4, 7, 11 &amp; 28 (approx. 8 min each). Program lasted for 6 wk and had a final follow up 2 wk post-completion.</p> <p><b>Outcome Measures:</b> Self Rated Health Scale (SRHS), Center for Epidemiologic Studies Depression Scale (CES-D)</p>	
<p><a href="#">Guest et al.</a>, (1997) USA Pre-Post N=15</p>	<p><b>Population:</b> Traumatic complete paraplegics; N=15; Gender: males=12, females=3; Mean age=28.8 yr; Mean time post injury=3.8 yr.</p> <p><b>Intervention:</b> Electrically stimulated walking program-32- sessions, using the Parastep® FNS ambulation system.</p> <p><b>Outcome Measures:</b> Tennessee Self-Concept Scale (TSCS), Beck Depression Inventory (BDI)</p>	<ol style="list-style-type: none"> <li>1. Physical Self-Concept: decreased after electrically stimulated walking (<math>p &lt; 0.05</math>). Those with lower baseline score had the most significant improvements.</li> <li>2. Depression: decreased after electrically stimulated walking (<math>p &lt; 0.05</math>).</li> </ol>
<p><a href="#">Bradley et al.</a>, (1994) USA Cohort N=37</p>	<p><b>Population:</b> Gender: males=24, females=13; Mean age=32.03 yr; Level of injury: tetraplegic=12, paraplegic=25; Mean time post injury=6.51 yr</p> <p><b>Intervention:</b> Intervention group: 3 mos. Functional Electrical Stimulation (FES) exercise program; Control group: no intervention.</p> <p><b>Outcome Measures:</b> Multiple Affect Adjective Check List (MAACLRL)</p>	<ol style="list-style-type: none"> <li>1. Increased in depression &amp; hostility for those who had unrealistic expectations of the FES program (<math>p &lt; 0.01</math> &amp; <math>p &lt; 0.05</math>, respectively).</li> </ol>