




# Prevalence and Interventions for Behavioral Pathology in Spinal Cord Injury

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## Abstract

Spinal cord injury (SCI) represents a significant life event for an individual, encompassing physiological, psychological, and social changes. The potentially traumatic or distressing nature of acquiring an SCI and the associated life changes that ensue following an injury can increase the risk of mental health concerns. This review aimed at identifying prevalence of behavioral pathologies and interventions following SCI across the world. To identify the articles of interest for this review, the search was narrowed by using the combination of search terms as follows: “Spinal Cord Injury”, “Depression,” “Anxiety,” “Psychological Impact,” “Quality of life,” and “Sexual dysfunction.” Prevalence of depression and anxiety was noted to be in the range of 7 to 47.7%. SCI patients were also commonly seen to be associated with sexual dysfunction. The pharmacological interventions included drugs such as phosphodiesterase inhibitors like sildenafil and tadalafil, whereas certain studies also mentioned a few devices like the penile vibratory stimulation and electroejaculation and vacuum erection devices. Apart from empowering and educating healthcare providers, neuromodulation has been shown to be an efficient treatment. Patients with SCIs have a suicide rate that is two to six times greater than that of general population. Effects of mindfulness on functional limitation and quality of life were promising. Guided Internet-delivered cognitive behavioral therapy showed improvement in depression and anxiety symptoms with appreciable adherence to therapy programs. Hyperbaric oxygen therapy showed improvement in depressed SCI patients.

## Keywords

- ▶ spinal cord injury
- ▶ anxiety
- ▶ depression
- ▶ sexual dysfunction
- ▶ suicide

## Introduction

Spinal cord injury (SCI) represents a significant life event for an individual, encompassing physiological, psychological, and social changes. The emotional, cognitive, and social manifestations following an SCI are highly individualized, fluctuate across time and setting. Living with SCI requires an individual to make changes in their life to account for new physical, psychological, social, and environmental realities. Adaptation is a natural process following an SCI and can

encompass internal elements such as grief/loss, feelings of uncertainty, changes in thinking processes, and alterations in identity/self-concept and sense of self-efficacy, as well as external elements, such as learning to navigate one's environment and social spaces with a disability, and addressing structural and systematic barriers and exclusion.<sup>1-3</sup> While many significant lifestyle changes occur within the first few years following an SCI, adaptation extends over the lifespan and is culture-, situation-, and context-dependent.<sup>1</sup> Whereas many psychological reactions to acquiring an SCI represent

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normal adaptation and processing a major life change, untreated distress can have negative impacts on rehabilitation outcomes and overall quality of life.<sup>4</sup> Because distress can result in reduced functional gains during initial rehabilitation treatment, increased follow-up care and medical comorbidities, and diminished health status and functioning, evaluation of mental health issues is warranted. The potentially traumatic or distressing nature of acquiring an SCI and the associated life changes that ensue following an injury can increase the risk of mental health concerns. Not surprisingly, some individuals with SCI do experience psychological distress, including clinical levels of depression and anxiety. Prevalence rates of clinical depression among those with SCI are estimated at 22 to 28%; rates of clinical anxiety are around 20%; and rates of posttraumatic stress disorder (PTSD) are around 12%; whereas among the general adult population in the United States, rates for clinical depression, anxiety, and PTSD are approximately 7, 3, and 3.5%, respectively.<sup>5</sup> It is important for providers to assess and monitor mood and psychological distress following injury, as untreated mental health conditions can impact pain levels, self-management, goal achievement during rehabilitation, length of hospitalization, and overall health and life satisfaction.<sup>6</sup>

## Methods

The objectives of this article were to review studies on prevalence of behavioral pathologies and interventions following SCI across the world in last 35 to 40 years. We included all types of original research, reviews of any kind (excluding case reports, case series), which focused on behavioral pathology after SCI or types of intervention post-SCI or both. We excluded studies that concerned neurosurgical or neurological issues and interventions related to it. We included studies with patients of any age and gender who had suffered from SCI. A literature search of the following databases in English language was conducted in May 2023 on PubMed and Google scholar; in addition, the reference lists of the pertinent literature were screened for the relevant studies. The search started with SCI and psychological impact. Further, to identify the articles of interest for this review, the search was narrowed by using the combination of search terms as follows: "Spinal Cord Injury", "Depression," "Anxiety," "Psychological Impact," "Quality of Life," and "Sexual Dysfunction." Data was reviewed, collected, and extracted, including details of the data authors, year of study, sample size, study design, and country. Intervention information included psychopharmacological, psychotherapeutic, and neuromodulation. Review objective was to identify prevalence of behavioral pathology in the community and interventions for the same. The quality of review was assessed using scale for the quality assessment of narrative review articles.

## Depression and Anxiety in SCI

While reviewing the literature we came across different studies that quoted varying figures for prevalence of

depression and anxiety in people afflicted with SCI. It was noted to be in the range of 7 to 47.7%, as presented in ► **Table 1**. A study by Judd et al reported the prevalence of depressed mood in people with SCI to be about 7%, whereas study done by Rabadi and Vincent reported it to be 47.7%.<sup>7,8</sup> Tzanos et al reported mild depression in 36% patients, moderate in 12.8%, and severe in 3.7%, whereas Bombardier et al reported depression in 10% and low mood in 20 to 38% patients.<sup>9–11</sup>

A cross-sectional study by Adhikari et al evaluated 95 patients and caregivers and found the prevalence of depressed mood to be high in the patients and high level of caregiver burden.<sup>24</sup> This study also reported a direct correlation between depressed mood in traumatic SCI and the caregiver burden among their caregivers. In contrast to this, Bombardier et al found the stable low depression among their study subjects in their cohort study.<sup>11</sup> A few studies also dealt with the factors associated with depression in patients with spinal cord injury. One of these studies was by Li et al, a cross-sectional study, which scrutinized the relationship between pain intensity and probable major depression in patients of SCI and concluded that pain intensity was related to greater risk of probable major depression, although it was not found to be significant after consideration of pain interference.<sup>25</sup> Another study by Lim et al evaluated anxiety and depression in patients with traumatic SCI and found that these patients had 1.33 times greater incidence of new-onset anxiety or depression.<sup>26</sup> In contrast to this, a cross-sectional study done by Saurí et al showed higher prevalence of probable major depression disorder (PMDD) in nontraumatic SCI (21.1%) as compared to traumatic SCI (13.8%).<sup>27</sup> Prevalence of anxiety disorders following SCI has been comprehensively studied in the meta-analysis by Le and Dorstyn, in which 18 independent studies were included consisting of 3,158 participants and reported the prevalence of generalized anxiety disorder and panic disorder to be 5% and agoraphobia to be 2.5%.<sup>28</sup>

## Sexual Dysfunction in SCI

SCI patients were also commonly seen to be associated with sexual dysfunction (SD). This has been primarily associated with problems with sensation and mobility, spasticity, control of the bladder and bowel, and pain management.<sup>29</sup> In certain instances, females have also been observed to experience orgasmic dysfunction and a loss of vaginal lubrication with SCI,<sup>30</sup> as mentioned in ► **Table 2**. The person's psychological condition, socioeconomic circumstances, and the information given on the subject during rehabilitation have been associated with the sexual health of this population.<sup>31</sup> ► **Table 2** also describes how SCI affects the Female Sexual Function Index and male sexual quotient, especially affecting orgasm in females and erectile function, ejaculation and orgasm in males, respectively.<sup>32,33</sup> While studying about the predictive factors of male SD after traumatic SCI, Ferro et al in their observational study reported that protective factors for SD are fixed partner and masturbation, whereas predictors of SD are erectile dysfunction, orgasmic, and infrequent SD.<sup>34</sup> Whether or not adequate sexual adjustment resources are provided to patients

**Table 1** Prevalence of depression in traumatic SCI across various studies

Study	Sample size	Study design	Diagnostic method (MDD)	Depression diagnosis (%)	Intervention
Fullerton et al 1981 <sup>12</sup>	30	Cross-sectional	SADS (MDD)	30.00	Antidepressants in one patient
Howell et al 1981 <sup>13</sup>	22	Cross-sectional	SADS (minor depression)	22.70	
Frank et al 1985 <sup>14</sup>	32	Cross-sectional	SSI (MDD)	37.50	
Judd et al 1986 <sup>7</sup>	84	Cross-sectional	SSI (MDD)	7.00	Antidepressants
Fedoroff et al 1991 <sup>15</sup>	55	Cross-sectional	PSE (mixed)	22.00	
Frank et al 1992 <sup>16</sup>	134	Cross-sectional	IDD (MDD)	13.00	
Tate et al 1993 <sup>17</sup>	30	Retrospective analysis	SSI (MDD)	23.00	
Kishi et al 1994 <sup>18</sup>	60	Cross-sectional	Modified PSE (MDD)	21.70	
Clay et al 1995 <sup>19</sup>	133	Cross-sectional	IDD (MDD)	13.50	
Dryden et al 2005 <sup>20</sup>	201	Cohort study	MR/ICD-9 (mixed)	28.90	
Banerjea et al 2009 <sup>21</sup>	8,338	Retrospective analysis	MR/ICD-9 (mixed)	26.70	
Findley et al 2011 <sup>22</sup>	8,334	Retrospective analysis	MR/ICD-9 (mixed)	26.20	
Rabadi and Vincent 2011 <sup>8</sup>	87	Retrospective analysis	MR/ICD-9 (mixed)	47.70	
Weeks et al 2011 <sup>23</sup>	67	Retrospective cohort study	MR/ICD-9 (mixed)	15.00	Antidepressants
Bombardier et al 2012 <sup>10</sup>	142	Cross-sectional survey	SCID (MDD)	10.00	
Bombardier et al 2016 <sup>11</sup>	168	Cohort study	PHQ-9	29.10	

Abbreviations: IDD, inventory to diagnose depression; MDD, major depression disorder; MR/ICD-9, Medical Records/International Classification of Diseases, Ninth Revision; ND, no data; PHQ-9, Patient Health Questionnaire-9; PSE, Present State Exam; SADS, Schedule of Affective Disorders; SCI, spinal cord injury; SCID, Structured Clinical Interview for DSM Disorders; SSI, semi-structured clinical interview.

with SCI was studied by Kathnelson et al, who reported that all participants found resources available to support sexual adjustment were inadequate and most of them thought that the healthcare providers lacked knowledge and comfort discussing sexuality after SCI.<sup>31</sup> Lim et al also studied the less looked upon factors contributing to SD in men with SCI, which included hormonal influences, psychological factors and secondary SCI complications and to address these factors physical activity, diet, and specific medications were recommended for symptom relief.<sup>35</sup> From all the above stated findings, it can be inferred that SD associated with SCI affects a person significantly and hence it becomes important to study the factors associated with it. In a study carried out by Barrett et al using qualitative semi-structured interview, which generated six inductive themes.<sup>36</sup> These themes included internalizing societal views and stigmatization, diminished sexual confidence, navigating communication, managing relationship dynamics, lack of sexual support provision, and intervention development recommendations. Building further upon these themes, Barrett et al conducted another qualitative study, in which they interviewed 16 healthcare professionals about the barriers and facilitators in supporting sexual functioning and satisfaction during rehabilitation after SCI.<sup>37</sup> This

was also a semistructured interview that generated five inductive themes, namely integrating sexual wellbeing in rehabilitation, sex-informed multidisciplinary teams, acknowledging awkwardness, enhancing approachability, and recognizing the partner. These studies helped identify the factors associated with SD leading to deterioration of lifestyle and to identify the factors to enhance sexual functioning. Several studies also delved into the interventions adopted, which included both pharmacological and surgical measures, as mentioned in ► **Table 2**. The pharmacological interventions included drugs such as phosphodiesterase inhibitors like sildenafil and tadalafil, which are the first-line agents for SCI-related SD.<sup>38–41</sup> Certain studies also mentioned a few devices like the penile vibratory stimulation and electroejaculation and vacuum erection devices, whereas surgical options like penile prosthesis were considered important in many patients with severe injury and minimal improvement with other measures.

### Substance Use Disorders in SCI

In a cross-sectional study on 1,619 participants, Clark et al studied the risk of pain medication misuse (PMM) after SCI

**Table 2** Prevalence of sexual dysfunction in SCI and their treatment modalities

Sexual dysfunction									
Sr. no.	Study	Author, year	Design	Sample size	Country	Outcome			
1	Sexual dysfunction in women with spinal cord injury living in Greece <sup>30</sup>	Tzanos et al 2021	Cross-sectional study	30	Greece	6.3% had SD with mean FSFI score of 14.4			
2	Sexual concerns after spinal cord injury: an update on management <sup>42</sup>	Alexander et al 2017	Narrative review		United States of America	Sexual activity and satisfaction decreased after SCI. Orgasm in 50% patients with SCI			
3	Spinal cord injury and women's sexual life: case-control study <sup>32</sup>	Merghati-Khoei et al 2018	Case control study	62 women (31 cases and 31 controls)	Iran	SQOL-F and FSFI significantly worse in cases versus controls			
4	Evaluation of sexual dysfunction in men with spinal cord injury using the male sexual quotient (MSQ) <sup>33</sup>	Miranda et al 2016	Cross-sectional study	295	Brazil	Erectile function, ejaculation, and orgasm most severely affected domains. MSQ provides a more comprehensive assessment			
5	Sociodemographic factors associated with sexual dysfunction in Mexican women with spinal cord injury <sup>43</sup>	Moreno-Lozano et al 2016	Cross-sectional study	83	Mexico	Negative correlation between age and FSFI scores			
6	Efficacy and safety of sildenafil in men with sexual dysfunction and spinal cord injury <sup>44</sup>	Ohl et al 2017	RCT	248 men	United States of America	Achieving and maintaining erection and ejaculation frequency significantly more with sildenafil (vs. placebo). Successful intercourse attempts and preference for sildenafil significantly more			
7	Non-invasive neuromodulation for bowel, bladder and sexual restoration following spinal cord injury: a systematic review <sup>45</sup>	Parittotokkaporn et al 2020	Systematic review	46 studies (n = 1801)	New Zealand	Most studies (43/46) reported improvements in bowel (5/5), bladder (32/35), and sexual (6/6) dysfunction after SCI. Quality of included studies had a high risk of bias and were inconsistent			
8	Male sexual dysfunction and infertility in spinal cord injury patients: state-of-the-art and future perspectives <sup>38</sup>	Di Bello et al 2022	Narrative review		Switzerland	Worldwide annual incidence of SCI is 40 to 80 cases per million population. PVS and EEJ, PDE5i, ICI, VEDs, and surgical as PP			
9	Male erectile dysfunction following spinal cord injury: a systematic review <sup>39</sup>	DeForge et al 2006	Systematic review	49 studies	Canada	Behavioral therapy, topical agents, intraurethral alprostadil, intracavernous injections, vacuum tumescence devices, penile implants, sacral stimulators, and oral medication; Penile injections produced an effective erection in 90% (95% CI: 83–97%) of men. 79% (95% CI: 68–90%) of patients who took sildenafil noticed success; the disparity in efficacy was not statistically significant			
10	Specific aspects of erectile dysfunction in spinal cord injury <sup>40</sup>	Ramos and Samsó, 2004	Narrative review		Spain	First-line treatment of choice is oral drugs, such as phosphodiesterase inhibitors (sildenafil, tadalafil, and vardenafil) Sublingual second-line treatments include intracavernous injections of prostaglandin E1, papaverine, and phentolamine, alone or in			

Table 2 (Continued)

Sexual dysfunction						
Sr. no.	Study	Author, year	Design	Sample size	Country	Outcome
11	Neuroprosthesis for individuals with spinal cord injury <sup>46</sup>	Kilgore et al 2023	Narrative review		United States of America	combination, which have been shown to be highly effective in the treatment of ED in men with SCI. Penile prostheses and neuroprosthesis of anterior sacral roots
12	Fertility in men with spinal cord injury <sup>41</sup>	Čehić et al 2016	Narrative review		Croatia	Sacral root stimulation can be used to activate bladder, bowel, and sexual function Phosphodiesterase-5 inhibitors, intracavernosal injections, vacuum devices and penile prostheses. Medically assisted ejaculation using penile vibratory stimulation or electroejaculation and via prostate massage or surgical procedures

Abbreviations: CI, confidence interval; ED, erectile dysfunction; EEJ, electroejaculation; FSFI, Female Sexual Function Index; ICI, intracavernosal injections; MSQ, male sexual quotient; PDE5i, phosphodiesterase 5 inhibitors; PP, penile prosthesis; PVS, penile vibratory stimulation; SCI, spinal cord injury; SD, sexual dysfunction; SQOL-F, sexual quality of life-female; VEDs, vacuum erection devices.

and concluded that the risk of PMM is found in individuals with SCI with caution to the prescribers to be aware of risk factors for PMM including substance use behaviors and psychological indicators such as loss of employment, financial constraints and interpersonal issues with spouse.<sup>47</sup>

### Suicidal Behavior in SCI

Patients with spinal cord injuries have an increased likelihood of suicide than that in the general population.<sup>48</sup> In the United States, patients with SCIs have a suicide rate that is two to six times higher than that of the general population.<sup>49</sup> In Denmark, the patients commit suicide five times more frequently than general population.<sup>50</sup> According to an Australian study, people with SCIs have a suicide rate that is 4.4 times higher, and according to one in Norway, the suicide rates among women and men with SCIs were 3.7 and 37.6 times higher, respectively, than in the corresponding general populations of men and women.<sup>51,52</sup> In a different study, 10 to 15% of patients who had SCIs said they had planned a suicide attempt within 6 months of their injury, and 50% of patients reported having suicidal thoughts.<sup>53,54</sup> It is socially and culturally taboo to document mental health symptoms, and the unwillingness of nonpsychiatric clinicians to talk about mental health symptoms with their patients is increasingly linked to mental health disorders and higher rates of suicide in patients with SCIs. Mental health issues are closely linked to suicide in both healthy individuals and those who have SCIs; therefore, medical staff who treat patients with SCIs, such as orthopaedic surgeons, neurosurgeons, and rehabilitation physicians, need to determine whether their patients are at risk of suicide and take the necessary action.<sup>55</sup>

### Psychological Impact of SCI

Certain studies examined the psychological impact SCI had over an individual and did not classify it into different categories like depression or anxiety. One of the studies by Gruener et al evaluated the psychological distress among individuals with SCI and central neuropathic pain and found that SCI patients with central neuropathic pain have higher levels of posttraumatic stress disorder, anxiety, stress, depression, and pain catastrophizing as compared to those without.<sup>56</sup> Another study with important findings regarding the psychological repercussions of a SCI was done by Peterson et al.<sup>57</sup> In this cohort study, the authors longitudinally studied 14,83,313 individuals, out of which 9,081 people had SCI and 14,74,232 were controls. This study found that adults with SCI had a significantly higher incidence of any psychological morbidity (59.1%) as compared to the controls (30.9%). Also, it was found that all psychological disorders were associated with central neuropathic pain in patients with SCI.

### Interventions for SCI

As mentioned in the studies stated before, the psychological morbidity associated with SCI was significant, making it

pertinent to study the measures to improve them. The role of mindfulness in ameliorating these symptoms has been evaluated in a few studies. A systematic review was done by Hearn and Cros, consisting of five studies, which assessed the role of mindfulness for pain, depression, anxiety, and quality of life in people with SCI and found that the support was mixed for the therapy with only one study showing significant decrease in depression and anxiety.<sup>58</sup> Another study by Bhattarai et al showed that mindfulness uniquely contributed to the higher quality of life above and beyond sociodemographic and injury-related variables.<sup>59</sup> Also, indirect effects of mindfulness on functional limitation and quality of life through pain were significant. Other psychological interventions like cognitive behavioral therapy were studied by Mehta et al, who reported that guided Internet-delivered cognitive behavioral therapy showed improvement in symptoms of depression and anxiety with 60% eligible participants recruited with high rates of program completion.<sup>60</sup> In addition to psychotherapy, application of hyperbaric oxygen therapy (HBO) was also studied for depression and anxiety in patients of SCI. One such study by Feng and Li comprised a randomized controlled trial performed with 60 participants divided into three groups of 20 participants.<sup>61</sup> One of these groups received HBO, another group received psychotherapy and the last group received conventional treatment. It was found that the Hamilton Depression Rating Scale score was significantly lower in the group that received HBO and psychotherapy as compared to the group that received conventional treatment, thus demonstrating that HBO could be a viable option in SCI patients. Other modalities of treatment like noninvasive neuromodulation were also evaluated. In a systematic review by Parittotokkaporn et al, which included 46 studies with 1,801 participants, among which improvements in bowel (5/5), bladder (32/35), and SD (6/6) were reported in 43 out of 46 studies.<sup>45</sup> The included studies' quality varied widely and was strongly correlated with bias. Role of pharmacological interventions has also been evaluated wherein efficacy and safety of sildenafil were studied in men with SD and SCI by Ohl et al.<sup>44</sup> It was reported in this study that sildenafil led to significantly higher frequency of achieving and maintaining erection and ejaculation, as compared to placebo. The number of sexual intercourse attempts that were successful was more leading to sildenafil being significantly more preferred as compared to placebo.

## Conclusion

SCI is a debilitating illness with its effects strewed not only on the physical health but also on the mental health of the afflicted persons. In this study, we focused upon the psychological impact of the illness, encompassing, but not limited to, depression, anxiety disorders, SD, substance use disorders, and suicidal behavior. The prevalence of depression and anxiety disorders was observed to vary across different studies, plausibly due to the different techniques used to

assess depression.<sup>62</sup> Studies that gauged depression with self-rating questionnaires had a higher prevalence of depression as compared to the studies which estimated it through clinician rated diagnoses via the standard diagnostic classificatory systems. Despite the discrepancy, rate of depression in patients with SCI is far more than that in the general population, making it an important area to invest our resources into. Another important area of distress was noted to be the SD resulting from the injury, including arousal difficulty, orgasmic dysfunction, inadequate vaginal lubrication, and dyspareunia.<sup>29</sup> The dysfunction was noted to be in both males and females, but far less studied in females. The qualitative studies related to the impact of SD in SCI have generated certain iterative themes like elimination of stigma around these topics and integration of sexual health in rehabilitation of the patients. Some studies reported about the association of central neuropathic pain with increased psychiatric morbidity in the form of increased prevalence of post-traumatic stress disorder, depression, anxiety, and pain catastrophizing as compared to those without psychotherapies including mindfulness-based therapy and cognitive behavioral therapy have shown to be effective in the treatment of depression and anxiety in patients with SCI. HBO has shown improvement in depressed SCI patients. As far SD is concerned, apart from empowering and educating healthcare providers, neuromodulation has been shown to be an efficient treatment along with pharmacological management in the form of phosphodiesterase-5 inhibitors like sildenafil.

## Conflict of Interest

None declared.

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