Title: Mindfulness- and Acceptance-based Interventions for People with Spinal Cord Injury: A Scoping Review

Running title: MABI for People with Spinal Cord Injury

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Abstract

Study design: Scoping review.

Objective: To synthesize the effects of mindfulness- and acceptance-based interventions (MABIs) on health-related outcomes of individuals with spinal cord injury.

Setting: The included studies were conducted across four countries: The United States, Iran, China, and The United Kingdom.

Methods: This review followed the Arksey and O'Malley framework and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews guideline. Seven databases were searched until November 2024 to identify studies published in English-language that evaluated MABIs' effects on health-related outcomes in people with spinal cord injury. Literature screening, data extraction, and quality assessment were conducted by two reviewers independently. A narrative data synthesis was conducted.

Results: Of 2389 records, nine studies were included with designs of randomized controlled trials (n=4), quasi-experimental studies (n=3), and case studies (n=2). Acceptance commitment therapy (n=4) and mindfulness-based interventions (n=5) were employed. MABIs demonstrated significant improvements in psychological health outcomes (depression, n=3; anxiety, n=3; stress, n=2) with medium-to-large effect sizes (η^2_p=0.112–0.223) and other health-related outcomes (chronic pain, n=1; functional independence, n=1; engagement in meaningful activities, n=1; and quality of life, n=1). Participants found the MABIs to be acceptable and satisfactory. Study quality varied from weak (n=6) to strong (n=2).

Conclusions: The findings generally support the acceptability and effectiveness of MABIs for improving the overall well-being of individuals with SCI. Future research directions regarding designing MABIs and exploring effectiveness mechanisms were recommended for maximizing its benefits.

Keywords: Spinal cord injury; mindfulness; acceptance; health outcomes; scoping review

Introduction

Spinal cord injury (SCI) is a damage to the spinal cord, resulting in sensory and/or motor impairment below the level of injury. SCI may occur due to traumatic and non-traumatic causes [1]. There were 20.6 million prevalent cases and 0.9 million incident cases in 2019 worldwide [2]. SCI can lead to permanent mobility impairments and varied medical complications [3]. In particular, people with SCI are vulnerable to developing mental health disorders due to lifestyle changes, with a prevalence rate of 12%–23% for depression [4] and 15%–32% for anxiety [5]. The impact of SCI on mental health can persist up to six months after discharge, increasing risks of developing complications and reducing quality of life [6]. Indeed, psychological interventions are essential during the rehabilitation phase of SCI. Various medical treatments have effectively addressed the mobility improvement and physical complications in SCI care [7]. In recent years, psychological interventions have been emphasized by clinicians and there has been a noticeable rise in research evaluating these approaches for people with SCI [8]. Two main waves of cognitive behavioral therapies and coping-oriented strategies have been utilized in prior research on individuals with SCI to alleviate depression and anxiety [9-11].

Mindfulness- and acceptance-based interventions (MABIs) are the most recent focus (the third wave) to help people be aware of and accept present thoughts, experiences, and emotions, in contrast to challenging beliefs emphasized by the second wave [12]. MABIs include mindfulness-based stress reduction, mindfulness-based cognitive therapy, acceptance-based approaches, compassion-based approaches, and dialectical behavior therapy. Mindfulness-based stress reduction combines body awareness and mindfulness meditation to reduce stress by addressing feelings, emotions, and behaviors [13]. Mindfulness-based cognitive therapy, cultivating conscious attention to thoughts and non-judgmental attitudes, was found to be beneficial in relieving post-stroke depression [14]. Acceptance commitment therapy (ACT) utilizing acceptance and commitment to enhance psychological flexibility has been used in people with SCI to control anxiety, depression, and stress [15]. Compassion-focused therapy involving compassionate mind training [16] and dialectical behavior therapy utilizing dialectical thinking [17], have both been shown to be beneficial in reducing depression.

MABIs have shown high benefits in several populations with disabilities, such as reducing depression, anxiety, stress, and pain in patients with multiple sclerosis [12] and stroke [18]. There are emerging studies applying MBAIs among individuals with SCI, suggesting positive effectiveness on both psychological (e.g., anxiety, depression, and stress) and physical (e.g., functional independence) health-related outcomes [15, 19, 20]. A recent narrative systematic review focused on the effects of mindfulness-based interventions on anxiety, depression, pain, and quality of life among people with SCI [6]. However, this review included only five studies, with two randomized controlled trials (RCTs) only. Moreover, many other types of MABIs such as acceptance-based

interventions were not included, and other health-related outcomes have not been explored in this review yet. Similarly, another systematic review on upper motor neuron disorders included only one mindfulness-based intervention study for people with SCI [21]. A recent scoping review evaluated mindfulness for health in adults with SCI. However, this review focused on mindfulness and included both non-intervention and intervention studies, with mindfulness as either the main or complementary component [22]. It remains challenging to draw conclusions and make evidence-based decisions based on a comprehensive review regarding the efficacy of MBAIs for people with SCI across varied health-related outcomes.

Considering the growing body of research in recent years, a scoping review of all types of MABIs among people with SCI is needed. This scoping review aimed to comprehensively review studies that examined the effects of MABIs on people with SCI. The specific objectives include: 1) to summarize characteristics (i.e., intervention content, provider, format, and intensity) of MABIs for people with SCI; 2) to synthesize the feasibility and acceptability of among people with SCI; 3) to synthesize the effects of MABIs on health-related outcomes among people with SCI.

Methods

The initial protocol of this review involved a systematic review and was preregistered with the International Prospective Register of Systematic Reviews (CRD42022298275). However, a scoping review was deemed more appropriate due to significant heterogeneity among designs, interventions, and outcome measures of eligible studies. Thus, the methodology of this review had some change from the initial review protocol registration. This review was reported in accordance with Arksey and O'Malley's 5-stage scoping

review methodological framework [23] and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR) guideline [24].

Stage 1: Identifying the research questions

The primary research question was: "What is known from the existing literature about the effectiveness of MABIs for people with SCI?" The specific research questions included: 1) What are the characteristics (i.e., intervention content, provider, format, and intensity) of MABIs for people with SCI? 2) How are the feasibility and acceptability of MABIs among people with SCI? And 3) What are the effects of MABIs on health-related outcomes among people with SCI?

Stage 2: Identifying relevant studies

A comprehensive search was conducted from the database inception until November 2024 in seven electronic databases: Pubmed, PsycINFO (via ProQuest), Cochrane Library, CINAHL Complete (via Ebscohost), Scopus, Academic Search Premier (via Ebscohost) and Embase. The search strategy was used: ((spinal cord injur*) OR paraplegi* OR tetraplegi* OR quadriplegi* OR SCI) AND (mindful* OR acceptance OR MABI OR MBCT OR MBSR OR ACT OR CFT OR CMT OR DBT OR meditat* OR (third wave) OR (mind-body) OR compassion* OR detachment OR (loving kindness) OR (loving-kindness)). Unpublished and grey literature searches were conducted using trial registries (i.e., clinicaltrial.gov and the WHO International Clinical Trials Registry Platform), Google Scholar, and ProQuest Dissertations & Theses. We conducted hand searches of

five common key journals relevant to our review topic: Archives of Physical Medicine and Rehabilitation, BMC Neurology, Disability and Rehabilitation, Spinal Cord, and The Journal of Spinal Cord Medicine. Reference lists of included studies were also hand-searched to identify relevant citations.

Stage 3: Selecting studies

Studies were included if they were: 1) types of studies: all randomized or non-randomized intervention studies with available full-text articles published in English; 2) participants: adults (aged 18 years old or above) with SCI; 3) interventions: studies conducted in clinical or community settings, in individual or group format, with a MABI as either a key compulsory part or the entire intervention. A MABI was defined as any intervention incorporating mindfulness and/or acceptance training as its main component, based on principles such as present-moment awareness, self-compassionate acceptance, and non-judgmental awareness [25]; and 4) outcomes: studies quantitatively evaluated one or more health-related outcomes, along with qualitative results if deemed relevant. Health-related outcomes are defined as pre-specified goal(s) or condition(s) that reflect the effect of intervention(s) on human subjects' health status or quality of life [26]. Data on adverse events were included if available. Studies were excluded if they were: 1) qualitative studies only; 2) studies using qualitative measures only; 3) non-intervention involved; 4) yoga interventions without a MABI as a key compulsory part; 5) brief research reports, abstracts, and protocols only; and 6) studies with less than 50% of the sample being SCI participants or with unclear sample composition. Two reviewers (ML and LWY) independently screened titles, abstracts, and full texts against the pre-defined inclusion and exclusion

criteria. Discrepancies were resolved by involving the third reviewer (YL). The selection process was documented in the PRISMA flow diagram (**Figure 1**).

Stage 4: Charting the results

A data extraction form was developed and piloted to capture the key characteristics of the included studies. The following information was extracted and presented in **Table 1**: 1) study characteristics: author(s), year of publication, country, design; 2) participant characteristics: sample size, age, gender, level and duration of SCI; 3) intervention (and/or control): intervention content, provider, format, and intensity; 4) feasibility: recruitment rate, withdrawal rate, and attendance rate; and 5) outcome measures: measurement tool, time points, and main results. One reviewer (LWY) extracted the data, with a second reviewer (ML) checked the extracted information and a third reviewer (YL) to resolve discrepancies.

Stage 5: Synthesizing and reporting the results

The key findings from the included studies were collated and summarized narratively. The summary focused on the characteristics, feasibility, acceptability, and effectiveness of MABIs among people with SCI. We used the Effective Public Health Practice Project (EPHPP) Quality Assessment Tool to evaluate the quality of both randomized and non-randomized studies across six components: selection bias, design, confounders, blinding, data collection method, and withdrawals/dropouts. The overall quality "strong, moderate, or weak" was determined after six components were assessed [27]. Two independent

reviewers (ML and LWY) conducted the quality assessment and resolved discrepancies through involving a third reviewer (YL).

Results

Studies retrieved

A total of 2389 studies were identified from the selected databases (n=2383) and other sources (n=6). After removing duplicates, 1692 records were screened for titles and abstracts. The full texts of 23 articles were retrieved and nine of them were finally included in the systematic review. The PRISMA flow diagram summarizes this process (**Figure 1**).

Study characteristics

Table 1 displays the characteristics of the included studies.

Study design and location

Nine studies adopted diverse designs including RCT (n=4) [13, 19, 20, 30], quasi-experimental design (n=3) [31-33], and case study (n=2) [15, 34]. Three studies collected qualitative data [13, 30, 32]. Five studies included follow-up assessments ranging from 1 to 3 months [13, 15, 19, 20, 30]. The included studies were conducted across four countries: The United States (n=3) [30, 32, 34], Iran (n=3) [15, 31, 33], China (n=2) [13, 19], and The United Kingdom (n=1) [20].

Characteristics of participants

A total of 300 patients were involved in nine included studies, with sample sizes ranging from two to 72. Half of them were male (50.3%), and the mean age was 45.8 years old. Six studies described the level of injury and 78.0% of the sample had paraplegia. Three

studies reported the etiology of injury, with traumatic SCI (86.0%) was primarily reported. Seven studies reported the time since injury, ranging from two weeks to 47 years. Participants were recruited from communities (n=4) [13, 20, 30, 32]; hospitals (n=2) [15, 34]; and rehabilitation centers (n=3) [19, 31, 33].

Characteristics of interventions

Content and provider. ACT (n=4) and mindfulness-based interventions (n=5) were mostly frequently adopted in included MABIs. These interventions varied in specific components: ACT (n=2) [15, 33]; ACT and psychoeducation (n=1) [32]; ACT and rehabilitation treatment (n=1) [19]; mindfulness-based pain management (n=1) [20]; mindfulness-based cognitive therapy (n=1) [31]; mindfulness, meditation, and imagery practices (n=1) [30]; mindfulness and motivational interviewing-oriented physical-psychological integrative intervention (n=1) [13], and virtual reality-enhanced dialectical behavioral therapy mindfulness skills training (n=1) [34]. Eight studies provided information on the intervention providers including nurses, psychotherapists, social workers, and licensed counselors.

Format and intensity. MABIs were delivered in mixed formats: face-to-face (n=4) for ACT [19, 31, 33, 34]; online (n=3) for ACT [32] and mindfulness-based interventions [13, 20] using videoconferencing or a web-based approach; hybrid (n=1) for mindfulness-based intervention [30]; and on-site with virtual reality goggles for dialectical behavioral therapy mindfulness skills training (n=1) [34]. Two studies provided mindfulness-based interventions individually [20, 34]. Five studies employed group sessions (5 to 15 participants per group) [13, 30, 31, 32, 33], and three of them also provided online resources for individual home-based practices. Most studies (n=6) delivered interventions

weekly, with each session lasting between 50 minutes and two hours, over a period of 4 to 12 weeks.

Study quality

The overall quality of included studies was two strong, two moderate, and four weak (**Table 2**). Two RCTs were rated as strong quality [20, 30]; one RCT [13] and was rated as moderate quality; and the rest six studies were rated as weak quality, with the reasons of having high selection biases, non-random design, and lack of blinding and control for confounders.

Feasibility and acceptability

The recruitment rate ranged from 10% [15] to 100% [33] (average 57.8%) in five reported studies. Withdrawal rates in the intervention group ranged from 0% [15, 34] to 41.7% [20] (average 16.7%). The attendance rate in the intervention group ranged from 72.2% [20] to 100% [15] (average 82.4%).

Three studies collected qualitative feedback on acceptability through individual semi-structured interviews [32], structured telephone interviews [30], and focus-group interviews [13]. Participants were satisfied with group videoconferencing to learn about shared experiences and videos convenient for home use [13, 30]. However, some participants faced challenges with scheduling videoconferencing sessions and uninterrupted time to practice and preferred in-person meetings. Suggestions were offered by study participants including increasing the number of intervention sessions,

individualized resources, online tracking of intervention practices [32], and developing new topics of interest [30]. No adverse events associated with interventions were reported.

Effects of the MABIs on health-related outcomes

Figure 2 presents the effects of MABIs on health-related outcomes among people with SCI reported by included studies.

Changes in psychological Health. (1) Depression: Six studies measured depression, all showing improvements. One ACT study indicated clinical significance [15], while two studies (one ACT and the other mindfulness-based intervention) showed statistical significance [20, 32], with large effect sizes at both post-intervention (η^2_p=0.184; *r*=0.51) and three-month follow-up (η^2_p=0.223). These findings demonstrate that ACT and mindfulness-based intervention can significantly alleviate depressive symptoms in people with SCI. **(2) Anxiety:** Four studies measured anxiety, and all showed decreases. One ACT study indicated clinical significance [15] and two studies (one ACT and the other mindfulness-based intervention) showed statistical significance [20, 32] with medium effect sizes at post-intervention (η^2_p=0.137; *Cohen's d*=0.48) and three-month follow-up (η^2_p=0.112). These findings indicate that ACT and mindfulness-based intervention can significantly alleviate anxiety in people with SCI. **(3) Stress:** Three studies measured stress and all identified decreases. One ACT study indicated clinical significance [15] and another ACT study showed statistical significance with a medium effect size post-intervention (*r*=0.47) [32]. These studies suggest that ACT can significantly reduce stress in people with SCI. And **(4) Other psychological health outcomes:** These outcomes were reported in one study only. Significant improvements were found in psychological flexibility (η^2_p =

0.377) and emotional regulation (η^2_p=0.335) at post-intervention for ACT [33]; grief (r=0.52) and self-compassion (r=0.49) at post-intervention for ACT [32]; post-traumatic stress disorder (PTSD) at two- and three-months follow-up for ACT (p<0.05) [19]; and psychological well-being (p<0.01) post the mindfulness-based intervention [31]. These improvements support the benefits of ACT and mindfulness-based intervention for individuals with SCI in terms of broader psychological health outcomes. In addition, a case study observed reduced depression, anxiety, and emotional upset following virtual reality-enhanced dialectical behavioral therapy mindfulness skills training [34].

Changes in other health-related outcomes. Three studies assessed chronic pain and one mindfulness-based pain management intervention study [20] found significant reductions in pain unpleasantness (η^2_p=0.137) and pain catastrophizing (η^2_p=0.110) with medium effect size at post-intervention, and continued significant reduction in pain catastrophizing with large effect size (η^2_p=0.239) at three-month follow-up. One ACT study reported significantly higher functional independence in the intervention group compared to the control group at two- (p=0.017) and three-month follow-up (p=0.007) [19]. Another mindfulness-based intervention study found improved physical activity post-intervention while the change was insignificant [13].

Additionally, one ACT study reported significant improvement in social health (i.e., engagement in meaningful activities) post-intervention (r=0.44) [32]. Three studies measured quality of life, and one of them utilizing mindfulness-based intervention found both significant time and group improvements, with a medium effect size (d=0.70) for group improvements in quality of life at three-month follow-up [13]. This study also demonstrated significant between-group improvements in exercise self-efficacy [13]. Two

mindfulness-based intervention studies reported changes in mindfulness and one of them showed significant improvement with a large effect size (η^2_p=0.22) post-intervention [20]. These findings suggest that ACT and mindfulness-based intervention also benefit individuals with SCI in a wide range of health-related outcomes beyond psychological health.

Three studies collected subjective feedback on changes following the interventions. Li (2024) reported that participants perceived improved mindfulness skills and mental well-being following the participation of a mindfulness-oriented intervention [13]. Han (2023a) identified two themes of a new way of thinking and equipped to deal with life challenges from ACT and psychoeducation [32]. With mindfulness, meditation, and imagery practices, SCI participants reported positive experiences of adopting new strategies to manage pain [30].

Discussion

To our knowledge, this is the first scoping review systematically synthesizing research evaluating the effects of MABIs on people with SCI. This review included nine trials evaluating MABIs, with ACT and mindfulness-based interventions primarily reported. These studies show varied feasibility, satisfactory acceptability, and significant effectiveness on a variety of health-related outcomes with particular benefits on psychological health. However, the number of research evidence in this area is limited and the quality of included studies (with only two RCTs rated as strong quality) remains to be improved. This review has also identified priorities that should be addressed in future studies.

Delivery of MABIs

Both face-to-face and online formats were utilized for delivering MBAIs. Owing to the advancement in telehealth, online platforms such as videoconferencing have been increasingly used to deliver psychological interventions [35]. Online interventions offer advantages such as cost-effectiveness, and flexibility in terms of time, geography, and mobility of the participants. However, some participants faced difficulties in finding uninterrupted time for online sessions and expressed a preference for face-to-face meetings [30]. To accommodate participants' preferences and enhance engagement, it is recommended to adopt a hybrid approach and closely monitor intervention acceptance. Notably, one case study introduced a virtual reality-enhanced MABI as a novel and immersive intervention for people with disabilities, potentially increasing compliance and alleviating anxiety and depression [34]. More MABIs were conducted in group sessions compared to individual formats in the reviewed studies. Group interactions that involve shared emotions and experiences facilitate engagement in the intervention and could be encouraged in the implementation of MABIs [13].

Feasibility and acceptability of MABIs

The included studies face various levels of difficulties in recruiting SCI participants. It is challenging to recruit participants with physical disabilities in different settings as reported in earlier studies [6]. However, the attendance and retention rates among SCI participants were notably high, comparable to those observed in a mindfulness trial with individuals experiencing recent onset psychosis [36]. This indicates a promising level of acceptability for MABIs among individuals with SCI , despite their physical limitations. In general, participants had positive feedback and satisfaction regarding the intervention

modality of group online learning and individual home-based practice [13, 30, 32]. These findings reflect a robust willingness among individuals with SCI to engage with MABIs, indicating that the content and delivery methods satisfied this population, which is crucial for the success of such interventions.

Effects of MABIs on health-related outcomes

The reviewed MABIs primarily showed significant medium-to-large effects in improving the psychological health of individuals with SCI, with reductions in depression, anxiety, and stress commonly reported, aligning with the effects of MABIs observed in people with stroke and multiple sclerosis [12, 18]. Both the ACT [32] and mindfulness-based interventions [20] in this review demonstrated significant immediate and prolonged effectiveness in reducing depression and anxiety among SCI patients. However, only a significant immediate improvement in stress was observed in one included study using ACT [32]. ACT was perceived as beneficial by SCI participants in enhancing psychological flexibility through accepting negative internal (e.g., emotions and thoughts) and external experiences (e.g., SCI-induced stressful situations). This was significantly associated with reduced negative psychological symptoms including depression, anxiety, and stress [32]. Mindfulness training for individuals with SCI may initiate cognitive reappraisal through increased present-moment awareness and acceptance of emotions, reduced experiential and behavioral avoidance, and less negative judgment, contributing to relieving depression and anxiety disorders [20]. In addition, one included study integrating dialectical behavioral therapy and mindfulness skills training suggest improvements in depression, anxiety, and emotional upset [34]; however, the sample size

was too small to indicate significant changes. The effectiveness of dialectical behavioral therapy on the psychological health of individuals with SCI remains to be explored.

MABIs (i.e., ACT) also demonstrated positive effects on other varied psychological health outcomes. One included study supported ACT had significantly immediate effects on increasing psychological flexibility and emotional regulation in individuals with SCI [33], consistent with studies on cancer patients [37]. ACT, as a psychotherapeutic method, can improve psychological flexibility and emotional regulation by utilizing cognitive detachment techniques and defusion exercises to cultivate acceptance of injury-related conditions, as well as optimism and patience [33]. The reviewed evidence suggests a mediating mechanism that ACT may help alleviate mental health disorders (e.g., anxiety, depression, and stress) by enhancing psychological flexibility and emotional regulation [32, 33]. Additionally, ACT was found to be immediately effective in increasing self-compassion, reducing grief [32] and showing sustained efficacy in relieving PTSD at follow-ups [19]. These findings were aligned with trials conducted in patients undergoing dialysis [38] and receiving palliative care [39]. Cultivating self-compassion using ACT can serve as a mechanism for symptom improvement in PTSD by reducing brain activation of the threat response system [40]. Additionally, one included study supported the benefits of mindfulness-based cognitive therapy in promoting psychological well-being by facilitating adaptive psychological functioning through trained present-moment awareness and acceptance among individuals with SCI [31].

In addition to psychological health, positive changes in other health-related outcomes including chronic pain and functional independence were identified following MABIs. Mindfulness-based pain management was shown to be effective in immediately reducing

pain unpleasantness and continually improving pain catastrophizing for people with SCI [20]. Mindfulness-based interventions may mitigate pain unpleasantness and catastrophic thinking in individuals with SCI by cultivating acceptance and decreasing attention paid to pain [6]. However, mindfulness-based interventions used in three included studies did not induce significant improvements in pain intensity for individuals with SCI [13, 20, 30]. The significant effectiveness of MABIs on reducing pain intensity has been demonstrated for patients with fibromyalgia in a meta-analysis [41], whereas the positive effect of mindfulness-based interventions and other types of MABIs in reducing pain for people with SCI remains to be examined in future trials. One included trial supported the integration of ACT with rehabilitation treatment, resulting in a significantly prolonged effectiveness in increasing functional independence [19]. It is suggested that ACT may contribute to physical functions among individuals with SCI by encouraging acceptance, attention to the present, and commitment to exercises and rehabilitation engagement [19].

One included trial with ACT demonstrated significantly increased engagement in meaningful activities among individuals with SCI [32]. This finding supported the effectiveness of MABIs in social health consequences and aligned with a study using ACT on family caregivers of people with dementia [42]. ACT is effective in encouraging engagement in meaningful daily activities by clarifying personal values and cultivating commitment to values-based behaviors in SCI patients. Three included studies investigating the quality of life, however, only one study using mindfulness-oriented intervention found statistically significant improvements with moderate effect size [13]. This mindfulness-oriented intervention study suggested enhancing quality of life by improving physical inactivity, depression, and chronic pain through cultivating

mindfulness and encouraging physical activities [13]. A recent meta-analysis found moderate to large effects of MABIs on improving the quality of life for people with multiple sclerosis [12]. However, insignificant improvements for quality of life were reported in a meta-analysis of MABIs for stroke survivors and a systematic review of mindfulness-based interventions for people with SCI [6, 18]. These mixed effects of MABIs on quality of life highlight the need for more research in this area.

Limitations

Despite employing rigorous and systematic methods for searching, evaluating, and synthesizing research evidence, several limitations should be acknowledged when interpreting the findings. A notable limitation of this review is the gender distribution among SCI participants, with only 50.3% identified as male in included studies. This ratio does not reflect the typical demographic profile of the SCI population, where males often comprise 70–80% of individuals affected, which hinders the generalizability of the review findings to this population [43]. The included studies featured small to moderate sample sizes from four countries, which may limit their representativeness due to limited statistical power and cultural differences. Over half of included studies were non-randomized controlled trials, which could intrinsically introduce selection bias. Half of studies only provided pre-and-post comparisons and a maximum follow-up period of three months in this review which also hindered the assessment of the long-term intervention effects.

This review primarily identified ACT and mindfulness-based interventions, with only one study using mindfulness skills training in dialectical behavioral therapy for people with SCI. There was limited exploration and restricted evidence of applying other types of MABIs for people with SCI. In addition, the scoping review approach we followed

precludes the weighting of strong versus weak quality studies in formulating conclusions. This review included a small number of studies published in English only, and the findings might be biased due to the limited research included in this review. All included studies were published, although a grey literature search was conducted. This raises the possibility that our conclusions may be limited and skewed by publication bias towards reporting positive effects.

Implication for future research and practice

Given the promising effects of MABIs on the health-related outcomes of people with SCI, studies with more rigorous designs (e.g. RCTs), larger sample sizes, and diverse settings are recommended to enhance the validity and representativeness of study findings. Moreover, intervention studies with follow-ups beyond three months are recommended to explore the long-term effects of MABIs. A hybrid modality of online and face-to-face MABIs are suggested to accommodate participants' preference. Virtual reality-enhanced MABIs can be introduced to the SCI participation to enhance engagement and maximize the intervention effectiveness. Resources for self-practice by participants are suggested to be provided after the completion of interventions that might help prolong the intervention effects [29]. Studies are encouraged to explore the intervention mechanisms explaining the effects of MABIs on health-related outcomes, such as the potential mediating effect that ACT may have to improve mental health by enhancing psychological flexibility and emotional regulation. Future studies can further explore the effects of other therapies of MABIs like compassion-focused therapy for SCI patients, which can contribute new knowledge to the current literature.

This review provides evidence supporting the use of MABIs among individuals with SCI to enhance a wide range of psychological, physical, and social health outcomes. Nurses, who are often the most accessible and trusted sources of health guidance, can be trained in certification programs and collaborate with health psychologists to provide MABIs for individuals with SCI. Tele-education with online participation options can be made available in cases where physical attendance poses a barrier to engagement. In particular, online-based and virtual reality-enhanced MABIs are encouraged to benefit this population with physical impairments, offering advantages in compensating for transportation barriers and enhancing engagement in interventions. Integrating MABIs into existing SCI rehabilitation programs could complement traditional physical rehabilitation therapies by promoting psychological well-being along with various health-related outcomes in addition to physical recovery.

Conclusion

The findings in this review supported the acceptability and effectiveness of MABIs on psychological health outcomes and other health-related outcomes for people with SCI. Future studies are suggested to utilize high-quality RCTs with long-term follow-ups to further evaluate the effectiveness of MABIs among individuals with SCI. The findings provide directions for future research, particularly for designing MABIs to maximize their positive effects and developing hypothetical theories or models that explain the intervention effectiveness.

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634 **Figure 1.** PRISMA flow diagram for selecting studies.
635 **Figure 2.** Graphic representation of the effects of MABIs on people with spinal cord
636 injuries reported by included studies.
637 **Table 1.** Data extraction of included studies.
638 **Table 2.** Quality assessments for included studies.