Title: Revealing the Protective Mindfulness-Moderation on Loneliness, Depression, and Quality of Life among Spinal Cord Injury Survivors in a Mixed-Methods Study

Running Head: Mindfulness Moderation of Loneliness Impacts

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Word count (main text excluding abstract, tables, figures, and references): 4564

Acknowledgments: None.

Declaration of Interest: The authors report there are no competing interests to declare.

Funding information: This study was supported by the Health and Medical Research Fund Research Fellowship Scheme, the Health Bureau, Hong Kong SAR [No. 06200147].

Data availability statement: The data that support the findings of this study are available from the corresponding author [YL], upon reasonable request.

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Abstract

Purpose: Loneliness, prevalent in people with spinal cord injuries (SCI), is negatively associated with mental health and quality of life. Mindfulness is a potential moderator that may buffer the negative impact of loneliness. This study aimed to explore the moderation effects of mindfulness on the relationship between loneliness, depression, and quality of life among people with SCI.

Methods: We conducted an explanatory sequential mixed-methods study on SCI survivors in Hong Kong. Survey data (n=72) including socio-demographics, mindfulness, loneliness, depression, and quality of life were analyzed using moderated regression with the SPSS PROCESS macro. Focus group interviews (n=15) were analyzed using thematic analysis.

Results: Mindfulness significantly moderated the positive association between loneliness and depression (B=-0.060, p=0.006), and a cut-off value (>116.569) for moderation was identified. The mindfulness moderation on the relationship between loneliness and quality of life was insignificant. Three themes were generated: connectedness contributes to subjective well-being, mindful perceptions foster emotional resilience and happiness, and mindful perceptions enhance physical health and social connections.

Conclusions: This study revealed the protective moderation mechanism of mindfulness in buffering the negative impacts of loneliness on depression, providing a strong theoretical foundation for the use of mindfulness-based interventions in improving mental well-being among SCI survivors.

Keywords: spinal cord injury; mindfulness; loneliness; depression; quality of life

Introduction

Spinal cord injury (SCI) is a neurological condition resulting from damage to the spinal cord, leading to loss of sensation, muscle function, or motor control [1]. The global incidence of SCI is estimated to be 40–80 cases per million worldwide [2]. In Hong Kong, approximately 200 cases of traumatic SCI are reported annually, and the prevalence of spinal metastasis, which may contribute to non-traumatic SCI, ranges from 1500 to 2000 cases annually [3]. Individuals with SCI often suffer from permanent disabilities and various secondary bio-psychosocial health problems [1]. Psychological morbidity such as depression is particularly prevalent following SCI [4]. Moreover, loneliness is a significant psychosocial health concern among individuals with chronic disabilities and is associated with mental health problems and a lower quality of life [5].

Loneliness is a subjective, unfavorable emotion that arises when individuals experience feelings of detachment or isolation, referred to as emotional loneliness; or when they lack a wider social network, known as social loneliness [6]. People living with SCI often experience loneliness due to physical disabilities and subsequent adverse changes to

lifestyle and social network [7]. Loneliness is prevalent among the SCI population, with 47.7% reporting a subjective perception of loneliness [8], significantly higher than the prevalence reported by the general population (11%) and individuals with chronic medical conditions (18%) [9]. Several studies have identified various risk factors for loneliness, including a lack of social support [10], low life satisfaction [11], and unfavorable socioeconomic status [12]. Moreover, individuals suffering from loneliness have been shown to possess significantly fewer psychosocial resources, which leads to a perception of low social support [5]. As people with SCI are susceptible to social isolation, this can arguably contribute to exacerbated feelings of loneliness [13].

Depression is one of the most commonly reported mental health problems occurring in the SCI population [4]. A meta-analysis reported a prevalence rate of 22% for depression among individuals with SCI [14]. Severe mobility impairments, along with associated decreases in protective neurotransmitters (e.g., dopamine) [15], as well as declining cognitive function [16], contribute to depressive symptoms in this population. In particular, the impact of SCI on mental health can persist for up to six months or even a lifetime after discharge [17]. Accompanied by lifelong disabilities and various complications, individuals with SCI often experience a significantly lower quality of life compared to the general population [5]. Higher levels of depression among people with SCI have shown consistent correlations with a diminished quality of life [18].

Recent research has recognized the critical role of loneliness in its association with mental health [19] and quality of life [20]. Loneliness is suggested to be linked with a negative cognitive style, that can contribute to a pessimistic interpretation of life events [21]. For individuals with SCI who suffer from significant disabling injuries, there is a

vulnerability to developing loneliness and accumulating mental health problems such as depression [8]. The absence of stress-buffering conditions such as emotional and social connectedness also has adverse impacts on quality of life [22]. However, studies exploring the influences of loneliness on depression and quality of life primarily focus on the elderly. Moreover, not all studies conclude that loneliness is negatively associated with mental health and quality of life [22, 23]. It is suggested that potential factors can moderate the adverse effects of loneliness, thereby protecting individuals from a decrease in mental well-being and quality of life.

The Loneliness Regulatory Loop Model suggests that feelings of loneliness increase vigilance for threats and vulnerability perceptions, resulting in self-reinforced social detachment and adverse health outcomes [24]. Emerging studies have identified that mindfulness, involving present-moment awareness and non-judgmental attitudes, plays an important and positive role in alleviating emotional isolation and encouraging social interactions by reducing maladaptive thought patterns [25]. Furthermore, evidence supports the positive impacts of mindfulness in improving depression as well as quality of life among individuals with SCI [26]. Recent evidence in older adults found that mindfulness significantly moderated the adverse impacts of loneliness on mental health; however, the moderating role of mindfulness on the relationship between loneliness and quality of life was found to be insignificant [27]. The moderating role of mindfulness in loneliness and related health outcomes is still underexplored in empirical studies and has not been tested in the SCI population.

Loneliness remains a significant health challenge faced by SCI survivors, likely contributing to increased depression and reduced quality of life. Mindfulness, as a

126 psychological skill, has the potential to break the loneliness regulatory loop by facilitating
127 acceptance and mitigating maladaptive cognition, thereby buffering the negative effects
128 induced by loneliness [25]. This study aimed to test a hypothetical model (**Figure 1**)
129 examining the moderating role of mindfulness on the effect of loneliness on depression and
130 quality of life in people with SCI. Additionally, a subsequent qualitative study was
131 conducted to enhance the understanding of the quantitative findings from the subjective
132 perspective of individuals with SCI.
133
134 **Methods**
135 **Design**
136 We employed an explanatory sequential mixed-methods design, including a
137 quantitative cross-sectional survey followed by a qualitative descriptive study, driven by
138 the pragmatism paradigm [28]. The survey was designed to test the hypothetical model
139 (**Figure 1**). The qualitative descriptive study used focus group interviews to explain the
140 model results from the perspective of individuals with SCI.
141
142 **Sample and setting**
143 We surveyed 72 participants from October 2022 to May 2023. All participants were
144 recruited from local non-government organizations, i.e., the Hong Kong Direction
145 Association for the Handicapped and the Hong Kong Federation of Handicapped Youth,
146 using posters, emails, and calls. The eligibility criteria were as follows: (1) adults (≥ 18
147 years old) diagnosed with SCI; (2) currently living in the community for at least 6 months;
148 and (3) able to speak Cantonese without communication or vision difficulties. We excluded

individuals with significant cognitive impairment (medical records or the Cantonese Mini-Mental State Examination score of <18 [29]), brain injury, and those unable to provide informed consent. For the focus group interviews, a maximum variation sampling method was used to purposively select participants who had completed the survey, ensuring diversity in terms of the level of mindfulness, socio-demographics (i.e., age and sex), and SCI characteristics (i.e., type and time since the injury). Finally, fifteen participants joined the online focus group until data saturation was reached, as no relevant new codes were found. Eight participants declined to participate in the interview due to time constraints.

Data collection

Quantitative data were collected online utilizing the following questionnaires.

Socio-demographic and injury information. We collected information on gender, age, education level, marital status, employment status, injury cause, injury level, and time since the injury.

Mindfulness. We used the 39-item Five-Facet Mindfulness Questionnaire to evaluate five aspects of mindfulness, including observing, describing, acting with awareness, non-judgmental, and non-reactive [30]. The scale uses a five-point Likert scale ranging from 1 (never) to 5 (always true), with higher total scores (39–195) indicating higher levels of mindfulness. The Chinese version of this scale demonstrated satisfactory reliability (Cronbach's $\alpha = 0.83$) in the community sample in Hong Kong [31].

Loneliness. The Chinese version of the De Jong Giverveld Loneliness Scale was used to assess loneliness [32]. It encompasses emotional loneliness (3-items) and social loneliness (3-items). The total score for these six items ranges from 0 to 6 with higher

scores indicating higher levels of loneliness. The scale also has one additional binary item to assess whether the respondents feel lonely or not. The scale demonstrated acceptable internal consistency with a Cronbach's α of 0.76 in elderly Chinese [32].

Depression. The Chinese version of the Patient Health Questionnaire was used to assess depression [33]. The scale ranges from 0 (not at all) to 3 (nearly every day), with higher scores indicating a higher level of depression. Total scores of 5, 10, 15, and 20 represented mild, moderate, moderately severe, and severe depression, respectively [34]. This scale demonstrated excellent internal consistency (Cronbach's α of 0.91) [33].

Quality of life. We used the 26-item World Health Organization Quality of Life Brief to evaluate quality of life. It uses a five-point Likert scale with four domains, i.e., psychological health, physical health, social relationships, and environment. Higher scores indicate a greater rated quality of life. The Hong Kong Chines version of this scale has shown strong psychometric characteristics and good reliability (Cronbach's α=0.89) [35].

Qualitative data were collected through four online focus group interviews with 15 participants following the quantitative survey. A semi-structured interview guide was used to explore participants' subjective perception of mindful status, loneliness, mental health, and quality of life. The interview questions were refined during the interview process and are presented in Supplementary Material S1. An experienced, trusted female social worker with a master's degree, who has training in focus group qualitative interviewing and established a rapport with interviewees, conducted the interviews to gather rich data. Filed notes were used to record key opinions and non-verbal behavior from participants. The interviewer, having the knowledge and interest in mindfulness, may introduce the bias on

194 the benefits of mindfulness during the interview. The focus group interviews lasted an
195 average of 70 minutes and were audio-taped with participants' consent.
196
197 **Data analysis**
198 IBM SPSS 26 (IBM Corp, Armonk, NY) was employed for quantitative data analysis.
199 Categorical variables were represented by frequencies and percentages. Continuous
200 variables were represented as mean (standard deviation, SD) for normally distributed data
201 and median (P_{25}, P_{75}) for skewed data. The chi-square test (χ^2) was applied to examine the
202 relationship between categorical variables, whereas the Student's t-test was used for
203 normally distributed continuous data and the Mann-Whitney U test was used for skewed
204 data.
205 Harman's one-factor model was used to verify the potential existence of the common
206 method variance. If the variance explained by the first common factor was less than 50%,
207 the data were considered free from common method variance [36]. The PROCESS macro
208 of SPSS with a simple slopes test and Johnson–Neyman test were used to examine the
209 moderation effects. Factors associated with depression and quality of life at $p < 0.05$ in the
210 bivariate analysis were controlled for the model tests. The sample size was determined
211 using G*Power 3.1 (Franz Fail, Germany). Based on the number of predictors (7 for
212 depression and 5 for quality of life), setting a medium-sized effect (f^2=0.15), α (two-sided)
213 =0.05, and 1-β=0.80, a minimum of 68 participants was needed. Thus, the study sample
214 size (n=72) was sufficient.
215 Qualitative data were analyzed using thematic analysis in six phases: familiarizing data,
216 generating initial coding, searching for themes, reviewing themes, defining and naming

themes, and producing the report [37]. The tape-recorded interviews were transcribed into Cantonese by one research assistant and cross-checked by another research assistant. Two authors with training in thematic analysis independently coded the transcripts, employing an iterative process that involved initial coding followed by theme identification. Any discrepancies in coding were discussed, and the final themes/subthemes were confirmed by the team and explained using verbatim data.

Rigor and reflexivity

To ensure the trustworthiness of the qualitative data interpretation, two authors independently coded the interview data [37]. Discrepancies in coding and final themes/subthemes were discussed within the team. Consistent comparisons were conducted during the coding process to identify theme patterns. Memos and reflective journals were used to ensure a critical and continued self-reflection on the researcher's influence. Thick descriptions of findings were provided to increase transferability. Both the transcripts and findings have been confirmed by the participants to enhance the validity.

Ethical consideration

The study was approved by the institutional review board [Ref No. xxx] (blinded for review) and it was conducted in accordance with the Declaration of Helsinki. We obtained informed consent from all participants. The purpose of the study was explained in detail to them before conducting the survey and interviews. Subjects were voluntary to participate in and free to withdraw from the study at any time without facing any penalty. Data confidentiality was protected and only authorized parties have the right to access the data.

Results

Descriptive statistics and bivariate analysis

Table 1 summarizes the descriptive statistics and bivariate analysis findings. The mean age of 72 participants was 57.61 (SD=8.68) years old. Half of them were female (55.6%). The majority had incomplete SCI (73.6%) and paraplegia (88.9%). Mean years post-SCI were 27.57 (SD=20.79). The occurrence of loneliness was 34.7%. Mean (SD) scores for mindfulness, depression, and quality of life were 124.51 (13.47), 6.03 (5.72), and 72.49 (10.79), respectively. Severe depression was significantly associated with younger age (p=0.033), higher injury level (p=0.005), and shorter time since injury (p=0.012). A better quality of life was significantly associated with married status (p=0.003) and lower injury level (p=0.007). Significant demographic and injury factors, i.e., age, SCI type, and year post-SCI were controlled for depression, while marriage and SCI type were controlled for quality of life in the subsequent model analysis.

Common method bias test and correlation analysis

The Harman's single-factor test showed that the variance interpretation percentage of the first common factor was 44.46% (< 50%), indicating controllable common method bias. **Table 2** displays the correlation matrix between loneliness, mindfulness, depression, and quality of life. Depression was significantly correlated with loneliness (r = 0.456, p < 0.01) and mindfulness (r = -0.304, p < 0.01). Quality of life was also significantly correlated with loneliness (r = -0.565, p < 0.01) and mindfulness (r = 0.484, p < 0.01).

Mindfulness-moderation model test

Table 3 shows the significant interaction effect between loneliness and mindfulness (B = -0.060, p = 0.006), indicating that mindfulness significantly moderated the relationship between loneliness and depression. However, as shown in **Table 4**, the moderating effect of mindfulness on the relationship between loneliness and quality of life was not significant (B = -0.020, p = 0.583).

According to the simple slope tests in **Figure 2**, loneliness had a statistically significant effect on depression at a low level of mindfulness (p=0.018). However, for those with moderate mindfulness (p=0.382) and high mindfulness scores (p=0.257), the effect was insignificant. The Johnson-Neyman test (**Figure 3**) revealed the cut-off value for mindfulness scores that moderate the association between loneliness and depression. When the mindfulness score (range: 39–195) was below 116.569, there was a positive correlation between loneliness and depression. However, this correlation was no longer significant when the mindfulness score exceeded this cut-off value. Moreover, when the mindfulness score was greater than 151.303, there was a negative correlation between loneliness and depression.

Qualitative results

As shown in **Table 5**, among the 15 interview participants, nine were females (60%). Thirteen participants (86.7%) had incomplete injuries and paraplegia. Their ages ranged from 37 to 65 years. The time since SCI ranged from 3 to 65 years. The level of mindfulness ranged from 102 to 161. Three themes were identified: connectedness contributes to

subjective well-being, mindful perceptions foster emotional resilience and happiness, and mindful perceptions enhance physical health and social connections.

Theme 1: Connectedness contributes to subjective well-being

Connectedness promises mental well-being. SCI participants often spend most of their time sitting in wheelchairs at home, which contributes to negative feelings such as emptiness and boredom. "*I usually have nothing to do at home. Sometimes I feel bored sitting in a wheelchair.*" (G2P2, male, tetraplegia, 9 years post-SCI). However, enhancing emotional and social connectedness through engaging in activities with companions made them feel fulfilled, relaxed, and enjoyable. "*I feel more fulfilled and relaxed and time flies so fast when I participate in activities with companions.*" (G1P2, male, paraplegia, 57 years post-SCI).

Connectedness with peers boosts social well-being. SCI participants made efforts to maintain social connectedness and foster good relationships, particularly with peers who shared similar experiences. "*I keep in touch with others who have disabilities. We have participated in activities such as attending dance classes. We send blessings during festivals. You are not alone.*" (G1P1, male, paraplegia, 60 years post-SCI). Another participant also shared that the sense of community among individuals with disabilities creates a safe and supportive environment for communication, even if trust is somewhat reserved. "*I feel that each other is willing to share and no more is attacking me because we are all people with disabilities. Of course, the level of trust is not absolute. There are always some reservations.*" (G3P1, female, paraplegia, 10 years post-SCI).

Theme 2: Mindful perceptions foster emotional resilience and happiness

Acceptance and non-responsiveness shape adaptive cognition and release negative emotions. SCI participants can address negative emotions by shaping adaptive cognitions using mindful perceptions such as acceptance. "*I've faced situations that have made me feel truly depressed recently. I allowed myself to feel down for a while, but then I told myself to try and accept the situation. Actually, I was able to get over this emotional low faster than many people*." (G2P1, female, paraplegia, 23 years post-SCI). Non-responsiveness is also a mindful trait used by participants to adaptively cope with negative emotions. "*Usually, it depends on whether you know how to let go of your negative emotions. If you feel too tense, don't respond to it. If you continue to react and rise emotions, your brain will break up*." (G2P3, female, paraplegia, 60 years post-SCI).

Awareness and non-judging make happiness from positive thinking. SCI participants can adopt positive thinking and find happiness through being aware of their experiences. "*I am aware of myself and what happened. Sometimes I recall what I did today and will be happy with such small things that I have done. People will become happier like this*." (G4P1, male, paraplegia, 23 years post-SCI). Adopting a non-judgmental attitude is an additional mindful trait that participants used to address pain and find happiness. "*I am smiling now despite having a headache. I didn't force a smile. I simply didn't judge the headache as something bad. Pain does not define everything about me. I can focus on various things that make me happy*." (G3P1, female, paraplegia, 10 years post-SCI).

Theme 3: Mindful perceptions enhance physical health and social connections

Awareness and acceptance promote active coping with physical discomforts. Being aware of self-health conditions help SCI participants actively find approaches to promote physical health and cope with pain disturbance. "*I previously was under bad health. Therefore, I am more aware of taking care of my physical conditions and also try to find approaches to relax from stress*." (G1P1, male, paraplegia, 60 years post-SCI). Acceptance is another strategy adopted by participants to relieve physical discomforts such as pain. "*I have a high tolerance for pain. I think pain is present, and whatever I do the pain is still here. I tried not to eat Panadol (pain medication) and accept the pain. Having something that can relieve pain is valuable*." (G3P1, female, paraplegia, 10 years post-SCI).

Acceptance and non-judging promote social interactions and relationships. Mindful perceptions such as acceptance help individuals with SCI to achieve satisfying social interactions and relationships. "*Sometimes we accept others, allow them to express freely, and then we express ourselves. The communications become tender and balanced. We feel happier and being respected."* (G4P1, male, paraplegia, 23 years post-SCI). Being non-judging also help create mutual respect and facilitate good relationship. "*You respect others without judgment and others will show mutual respect for you. The atmosphere and relationship will be good*." (G3P1, female, paraplegia, 10 years post-SCI).

Discussion

This study tested the moderating effect of mindfulness on the relationship between loneliness, depression, and quality of life among people with SCI in a mixed-methods approach. Loneliness was found to be significantly associated with increased depression and reduced quality of life. In particular, this study revealed that mindfulness significantly

moderated the association between loneliness and depression among SCI survivors. Qualitative findings further supported that mindful perceptions are beneficial in alleviating depressive emotions and promoting physical and social well-being by encouraging positive thinking and social interactions. This evidence highlights the importance of cultivating mindfulness as an effective psychological resource to prevent the deterioration of mental health and quality of life associated with loneliness.

A considerable percentage of individuals with SCI experiencing loneliness was found in this study. The occurrence of loneliness in this study (34.7%) was lower than that in an earlier study (47.7%) [8]. The difference could be attributed to the fact that our study sampled a relatively lower percentage of individuals with tetraplegia, who have higher levels of injuries and physical disabilities, compared to those with paraplegia. Additionally, evidence suggests that loneliness decreases as time since injury increases [10], and our sample reported a longer mean duration since SCI (27 years) compared to the earlier study (10 years) [8]. Our qualitative findings suggest that SCI participants still desire to be reconnected despite perceiving loneliness and make efforts to connect with their peers, which aligns with the Loneliness Regulatory Loop Model [24]. The findings suggest that reconnecting isolated SCI survivors with trusted persons such as peers who share similar injury experiences, can meet their special needs for social reintegration and create a safe social environment for interaction, thereby reducing loneliness. However, the findings are based on the focus group interview participants who may be more inclined to benefit from peer interactions. Future research is recommended to validate this finding with a more diverse sample.

The study sample generally reported mild levels of depression and medium levels of quality of life, consistent with previous studies on people with SCI [26]. The study results also demonstrated a significant moderate positive association between loneliness and depression, as well as a significant moderate negative association between loneliness and quality of life. These findings are consistent with research conducted in older populations [19, 38]. Our qualitative findings also support the idea that emotional and social connectedness enhance mental and social well-being in individuals with SCI. Our study findings suggest that the experience of loneliness may have detrimental effects on the mental health and overall well-being of adults with SCI. These findings emphasize the importance of addressing the adverse effects of loneliness, which, while common among individuals with SCI during their long-term rehabilitation, have been neglected in research.

Importantly, a significant moderating effect of mindfulness on the positive association between loneliness and depression was identified in this study, which was consistent with the study findings reported in a survey among the elderly [27]. Specifically, higher levels of mindfulness (above 116.569) experienced by individuals with SCI weakened the positive association between loneliness and depression. Awareness and acceptance, two fundamental elements of mindfulness, act as protective factors by weakening the regulatory loop of loneliness thereby reducing its negative effects [24]. Additionally, non-responsiveness and non-judgmental attitudes embedded in mindful cognitive processing, are beneficial for individuals to mitigate mental health problems [39, 40]. Our qualitative findings also suggest that these mindful perceptions facilitate adaptive cognitive patterns to accept adverse experiences and release negative emotions. Furthermore, the quantitative results surprisingly revealed that loneliness contributed to lower levels of depression when

mindfulness exceeded a certain high threshold of 151.303. The Chinese philosophy of achieving inner peace through the experience of solitude may explain this finding [41]. However, the positive association between loneliness and mental health at conditional high mindfulness was not observed in an Australian survey [42], although loneliness showed an insignificant association with psychological distress for those with high trait mindfulness. Future studies are encouraged to explore cultural differences in the moderation effect of mindfulness. Our study findings highlight the importance of employing mindfulness-based interventions, such as mindfulness-based stress reduction and mindfulness-based cognitive therapy, to enhance mental health [43, 44]. Furthermore, we recommend that the cut-off values be used as guidelines to optimize the effects of mindfulness-based interventions for individuals with characteristics similar to those of our study sample.

However, our quantitative results did not support the significant moderating role of mindfulness in the relationship between loneliness and quality of life, which also aligned with the earlier research [27]. This may be related to the complex nature of quality of life and its multifaceted influencing factors. An additional possible explanation is that mindfulness functions through the mechanism of mental processes in shaping emotional and cognitive traits [45]. In terms of physiological or environmental aspects, mindfulness may show no significant buffering effects on physical and social well-being [26]. Future studies are recommended to explore alternate moderators for the relationship between loneliness and quality of life. Despite this, our quantitative findings showed that higher levels of mindfulness were significantly associated with superior quality of life. Furthermore, the results from the qualitative interviews suggested that mindful features, such as awareness and acceptance, contributed to individuals' active coping with their

physical health problems and improving their physical well-being. Participants with SCI also reported benefiting from adopting acceptance and non-judgmental attitudes, which helped them reduce perceived social threats, increase their ability to engage in social interactions, and enhance their social well-being.

This study is the first to examine the moderating effect of mindfulness on the relationship of loneliness to depression and quality of life among people with SCI using a mixed methods approach. This study also provides a strong theoretical foundation for the use of mindfulness-based interventions to promote subjective well-being, particularly in terms of mental health, among individuals with SCI who are prone to experiencing loneliness. The important cut-off values for mindfulness scores moderating the relationship between loneliness and depression were identified in this study, which can serve as a reference for guiding the implementation of mindfulness-based interventions in clinical practice. Notably, individuals with SCI face specific challenges in mindfulness practice, such as difficulties with body scans and physical movements due to impaired sensation and motor functions [46]. Community healthcare providers such as nurses, who are the most accessible and trusted by community-dwelling residents, can be trained to facilitate mindfulness practice for individuals with SCI. Additionally, peers are valuable resources for promoting the social reintegration of SCI survivors and can be encouraged to facilitate mindfulness and broader health interventions, as indicated by our qualitative findings.

Several limitations should be noted in the interpretations of the findings. We acknowledge a notable limitation of this study regarding gender distribution, with only 44.4% of participants identified as male. This does not reflect the typical SCI demographic, where males comprise 70–80% of the population, potentially limiting the generalizability

of our findings [47]. The sample consists mainly of long-term community-dwelling SCI survivors (average 27 years post-injury), which requires caution in generalizing the results to those in the early stage. The cross-sectional nature limits the ability to draw causal conclusions or determine the long-term sustainability of the effects. The relatively small sample size restricts the power to detect the statistical significance and generalizability of our findings. Finally, the use of self-reported data may raise concerns about reporting bias, although the common method variance is acceptable in this study. Future research using a prospective and longitudinal design is recommended to explore the sustained effects of mindfulness in individuals with SCI. Additional studies are encouraged to explore the relationship between loneliness, quality of life, and mindfulness. Recruiting participants from various settings and time periods post injury, is also recommended to ensure a more representative sample, thereby enhancing external validity and increase understanding of the potential benefits of mindfulness for a diverse sample. Objective measurements are encouraged in future studies, including physiological measures such as heart rate variability monitoring related to depression and mindfulness [48].

Conclusion

The study findings indicate that a higher level of loneliness is associated with greater levels of depression and lower quality of life. Mindfulness significantly moderates the relationship between loneliness and depression, suggesting its high potential as an intervention for protecting SCI survivors with loneliness from developing mental health problems. Mindfulness is associated with a better quality of life and can be encouraged to benefit the overall well-being of individuals with SCI.

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Figure 1. The hypothetical moderation model of the study.

Figure 2. The relationship between loneliness and depression as moderated by mindfulness.

Figure 3. The visualization of mindfulness-moderation by Johnson-Neyman test.

Table 1. Descriptive statistics and bivariate analysis findings [N=72].

Variables	*n* (%)	Depression		Quality of life	
		B/*F*/*Z*	*p*	*B*/*t*/*F*	*p*
Age [Mean (*SD*), years]	57.61(8.68)	-0.166[a]	0.033	0.281[a]	0.056
Sex					
Male	32 (44.4)	-1.469[b]	0.188	0.667[d]	0.507
Female	40 (55.6)				
Marriage					
Single	30 (41.7)	-1.928[b]	0.054	-3.033[d]	0.003
Married	42 (58.3)				
Educational level					
Primary	15 (20.8)				
Secondary	47 (65.3)	0.315[c]	0.575	1.454[c]	0.241
College or above	10 (13.9)				
Employment					
Full-time	4 (5.6)				
Part-time	15 (20.8)	1.951[c]	0.377	0.919[c]	0.404
Unemployed	53 (73.6)				
SCI degree					
Complete injury	17 (23.6)	-0.193[b]	0.847	-0.211[d]	0.833
Incomplete injury	55 (76.4)				
SCI type					
Tetraplegia	8 (11.1)	-2.809[b]	0.005	-2.758[d]	0.007

Paraplegia	64 (88.9)				
Year post-SCI [Mean (*SD*)]	27.57(20.79)	-0.081[a]	0.012	0.088[a]	0.155
Loneliness [Mean (*SD*)]	4.00 (1.65)	1.577[a]	<0.001	-3.686[a]	<0.001
Yes	25 (34.7)	-4.332[b]	<0.001	-3.747[d]	0.001
No	47 (65.3)				
Mindfulness [Mean (*SD*)]	124.51 (13.47)	-0.129[a]	0.009	0.387[a]	<0.001
Depression [Mean (*SD*)]	6.03 (5.72)	—	—	-1.331[a]	<0.001
Quality of life [Mean (*SD*)]	72.49 (10.79)	-0.374[a]	<0.001	—	—

Note. SCI, spinal cord injury. SD, standard deviation. [a] *B* value. [b] Z value. [c] *H* value. [d] *t* value.

614

615 **Table 2.** Correlations between loneliness, mindfulness, depression, and quality of life.

	Loneliness	Mindfulness	Depression
Mindfulness	-0.379**		
Depression	0.456**	-0.304**	
Quality of life	-0.565**	0.484**	-0.706**

616 Note. ** $p < 0.01$.

617

Table 3. The moderated effect of mindfulness on depression.

Variable	*B*	*SE*	*t*	*p*	LLCI	ULCI
Outcome: Depression						
Constant	5.634	11.897	0.474	0.637	-18.133	29.401
Age	-0.029	0.059	-0.481	0.632	-0.147	0.090
SCI type	-1.059	1.577	-0.671	0.504	-4.208	2.091
Year post-SCI	-0.065	0.026	-2.467	0.016	-0.117	-0.012
Quality of life	-0.307	0.060	-5.160	<0.001	-0.426	-0.188
Loneliness	7.746	2.661	2.911	0.005	2.430	13.062
Mindfulness	0.212	0.081	2.609	0.011	0.050	0.374
Loneliness × Mindfulness	-0.060	0.021	-2.836	0.006	-0.102	-0.018
Increase of R^2 with interaction	R^2		F		p	
	0.051		8.042		0.006	
Conditional direct effects of mindfulness on depression						
Mindfulness	*B*	*SE*	*t*	*p*	LLCI	ULCI
M - 1SD	1.109	0.456	2.432	0.018	0.198	2.020
M	0.304	0.345	0.881	0.382	-0.385	0.994
M + 1SD	-0.501	0.438	-1.144	0.257	-1.375	0.373

618 Note. *SE*, Standard error. *LLCI,* Lower level of confidence interval. *ULCI*, Upper level of
619 confidence interval.

620

Table 4. The moderated effect of mindfulness on quality of life.

Variable	*B*	*SE*	*t*	*p*	LLCI	ULCI
Outcome variable: Quality of life						
Constant	42.490	19.247	2.208	0.031	4.051	80.929
Marriage	1.880	1.732	1.085	0.282	-1.579	5.338
SCI type	4.339	2.704	1.605	0.113	-1.061	9.739
Depression	-0.889	0.178	-5.009	<0.001	-1.244	-0.535
Loneliness	0.966	4.531	0.213	0.832	-8.083	10.015
Mindfulness	0.255	0.138	1.851	0.069	-0.020	0.530
Loneliness × Mindfulness	-0.020	0.035	-0.552	0.583	-0.090	0.051

Increase of R^2 with interaction	R^2	F	p
	0.002	0.305	0.583

Note. *SE*, Standard error. *LLCI*, Lower level of confidence interval. *ULCI*, Upper level of confidence interval.

Table 5. Characteristics of focus group interview participants.

Group	Case No.	Age	Gender	SCI Type	Years post-SCI	Mindfulness score[#]
Group 1	G1P1	62	Male	Paraplegia	60 [a]	124 [b]
	G1P2	61	Male	Paraplegia	57 [a]	148 [b]
	G1P3	63	Female	Paraplegia	54 [a]	130 [b]
Group 2	G2P1	63	Female	Paraplegia	23	126 [b]
	G2P2	48	Male	Tetraplegia	9	117 [b]
	G2P3	64	Female	Paraplegia	60 [a]	161 [b]
	G2P4	60	Male	Tetraplegia	7	115
	G2P5	44	Female	Paraplegia	9	139 [b]
Group 3	G3P1	37	Female	Paraplegia	10	151 [b]
	G3P2	65	Female	Paraplegia	65 [a]	102
	G3P3	65	Female	Paraplegia	65 [a]	108
Group 4	G4P1	50	Male	Paraplegia	23	123 [b]
	G4P2	62	Female	Paraplegia	19	125 [b]
	G4P3	65	Female	Paraplegia	3	131 [b]
	G4P4	60	Male	Paraplegia	47 [a]	125 [b]

Notes. [a] Indicating a value above the average years post-SCI (27.57). [b] Indicating a value above the cut-off (116.569) for mindfulness that moderates the association between loneliness and depression. [#] The total score of mindfulness was assessed using the Five-Facet Mindfulness Questionnaire.