Journal of Integrative Medicine 23 (2025) 660–669

Contents lists available at ScienceDirect

Journal of Integrative Medicine

journal homepage: www.jcimjournal.com/jim
www.journals.elsevier.com/journal-of-integrative-medicine

Original Research Article

Home-based acupressure for managing constipation and subjective well-being in spinal cord injury survivors: A randomized controlled trial

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ARTICLE INFO

Article history:
Received 11 July 2024
Accepted 10 January 2025
Available online 7 August 2025

Keywords:
Spinal cord injury
Acupressure
Constipation
Subjective well-being
Psychological health
Quality of life

ABSTRACT

Background: Spinal cord injury (SCI) survivors often experience constipation, which contributes to a reduced sense of well-being and a lower quality of life. Acupressure offers a non-pharmacological and non-invasive alternative therapy for treating constipation.
Objective: This study examined the effects of home-based acupressure on constipation and subjective well-being among SCI survivors.
Design, setting, participants and interventions: This randomized controlled trial randomly assigned 80 adults from Hong Kong with SCI to two study groups. Using a video demonstration filmed by a registered traditional Chinese medicine practitioner, the intervention group performed home-based acupressure (self-administered or caregiver-assisted) twice daily, 15 min/session, for 10 consecutive days. The control group performed manual light touching of the abdomen with the same frequency and duration as the intervention group. Both groups received defecation education through a structured booklet.
Main outcomes measures: The primary outcome was constipation severity. Secondary outcomes included bowel habits, psychological well-being, and quality of life. Focus group interviews were conducted after the intervention to collect subjective feedback from participants.
Results: Significant group-by-time interaction effects on constipation severity ($P = 0.005$) and quality of life ($P = 0.001$) revealed that home-based acupressure produced better results than the control. These treatment effects persisted at the one-month follow-up and continued to have a large effect size (Cohen's $d > 0.8$). Compared to the control group, the acupressure group also had improvements in anxiety (Cohen's $d = 0.69$) and depression (Cohen's $d = 0.72$) at the end of the intervention period. Three qualitative categories were identified from the focus group interviews: improvements in bowel function and management; reduced psychological distress following relief from constipation; and acceptability of home-based acupressure.
Conclusion: Acupressure effectively relieves constipation, enhances psychological well-being, and improves quality of life in people with SCI. These data provide novel evidence supporting the use of home-based acupressure as an acceptable and effective therapy for treating constipation after SCI.
Trial registration: ClinicalTrials.gov (NCT05558657).
Please cite this article as: Li MQ, Li Y, Lam W, Yeung WF, Ho YS, Li JY, Sun TC, Yuen S, Hu YL, Yorke J. Home-based acupressure for managing constipation and subjective well-being in spinal cord injury survivors: A randomized controlled trial. *J Integr Med*. 2025; 23(6):660–669.

1. Introduction

Spinal cord injury (SCI) refers to damage to the spinal cord that results in multi-sensory, motor and autonomic dysfunctions [1]. In 2019 the global prevalence of SCI was 20.6 million, with 0.9 million new cases and an age-standardized increasing trend of 0.1% annually [2]. SCI places significant healthcare burdens on survivors,

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https://doi.org/10.1016/j.joim.2025.08.001

caregivers, and the medico-social system [3]. Currently, thousands of SCI survivors live in the community in Hong Kong [4]. However, the availability of home-based healthcare programs to manage their dysfunctions is still limited [5].

Due to multiple dysfunctions and associated psychosocial factors, SCI survivors are vulnerable to developing neurogenic bowel dysfunction with constipation as a prevalent symptom [6]. The prevalence of constipation among this population (40%) [7] is considerably higher than that of the general population (12%–17%) [8]. Constipation may lead to serious complications like bowel obstruction [9]. Constipation causes 163,100 hospital days annually in the UK, with a cost of £162 million [10]. In addition, constipation negatively impacts the subjective sense of well-being, with studies conducted in different contexts including Chinese revealing associations between decreased bowel function, depression, and low quality of life among SCI survivors [11–13]. Constipation-related symptoms often worsen over time after an SCI, highlighting the need for accessible and effective therapies for home-based SCI survivors [14].

Constipation treatments commonly include conservative approaches, such as laxatives and diet therapy, and surgical interventions (e.g., colostomy) [15,16]. Surgery is typically reserved for severe cases due to its invasive nature and risk of complications [17]. Laxatives are the most commonly used conservative approach; however, long-term use of laxatives can lead to dependence, colonic melanosis, and potential worsening of constipation [18]. Dietary interventions, such as high-fiber diets, are the least harmful approach for treating constipation, but their benefits vary among individuals and are limited when used alone [9].

Clinical guidelines recommend alternative and complementary therapies for treating constipation [19]. Acupressure, a non-invasive complementary therapy rooted in traditional Chinese medicine (TCM) meridian theory, can regulate visceral function by applying pressure along meridian-positioned acupoints [20]. The neural mechanism reveals that acupuncture, based on the same meridian theory, can enhance the functioning of visceral organs by activating somatovisceral reflexes and biomechanical responses [21]. Acupressure has shown effectiveness for alleviating constipation among mobility-impaired populations like stroke survivors [22]. Importantly, acupressure can be self-administered at home. Self-administered acupressure has demonstrated its effectiveness for improving constipation and quality of life among psychiatric patients in a ten-day program [23], as well as enhancing pain management and quality of life among mobility-challenged individuals with probable knee osteoarthritis [24].

Home-based acupressure can be a promising approach to benefit the considerable number of individuals with SCI living at home, who have difficulty accessing health services [25]. However, the use of acupressure for treating constipation in this population is still underexplored. This is the first randomized controlled trial to examine the effectiveness of home-based acupressure for improving constipation and subjective well-being for SCI survivors. Qualitative data were collected through interviews after the cessation of treatment to explore patient opinions on the acceptability of the intervention and to contextualize treatment effects. The findings provide novel evidence supporting the use of acupressure as an accessible and effective therapy for SCI survivors.

2. Material and methods

2.1. Study design

We adopted an open-label, two-parallel-arm randomized controlled trial to examine the effectiveness of home-based acupressure. Further, focus group interviews were conducted immediately after the intervention to collect subjective feedback from participants for supplementing the interpretation of quantitative data. The study protocol was ethically approved (No. HSEARS20221031003), prospectively registered (No. NCT05558657), and has been published [26]. This report was prepared in accordance with the Consolidated Standards of Reporting Trials (CONSORT) reporting guideline.

2.2. Participants

Participants were recruited from a local non-government organization "the Hong Kong Direction Association for the Handicapped." Potential participants were contacted through email and phone calls to extend an invitation, and posters were also used to promote participation. Inclusion criteria were: (1) adults (≥ 18 years old) living at home with SCI for over 6 months [27]; (2) complete SCI at C6 or below or incomplete injury at any level with sufficient arm movement to perform acupressure; (3) willing to learn and perform acupressure (or caregiver-assisted); and (3) defecation ≤ 3 times/week [28] or having defecation complaints. Exclusion criteria were: (1) currently receiving bowel function interventions or acupoint treatments; (2) gastrointestinal organic disease history; or (3) medical diagnoses/conditions that prevent active participation (e.g., severe metabolic, cardiovascular or mental illnesses). In the absence of prior research on acupressure for constipation in individuals with SCI, the sample size calculation was based on Cohen's *d* with a standard medium effect size of 0.7, considering a range of 0.5–0.9 from studies on adults with stroke [22], cancer [29] and psychiatric diseases [23]. To estimate the between-group difference with an effect size of 0.7, 80% power, two-sided 5% significance, and a 15% attrition rate, 39 participants were required for each study group using G*Power 3.1.9.7. Qualitative focus group interviews after the completion of the intervention period were conducted with purposive sampling until data saturation was met [30].

2.3. Randomization and masking

Eligible participants were randomly assigned to two study groups (1:1) using the block randomization method. To ensure allocation concealment and balanced group numbers, the random assignment was conducted by an external administrator using an online randomization service website (sealedenvelope.com) with a random permuted block size of six. Upon written consent and the completion of the baseline assessment, the external administrator entered the participant numbers into the Sealed Envelope website to determine group assignment. The group allocation assignment was subsequently disclosed to the research team and participants. Participants could not be masked due to the intervention nature and were reminded to keep it confidential to prevent contamination. The data analyst was blinded to group allocation.

2.4. Interventions

The intervention group received the home-based acupressure program. The acupressure protocol for SCI survivors managing constipation was developed based on a comprehensive literature review [23,31–33] and validated by an expert panel of seven registered TCM practitioners and researchers, with a good content validity index of 85.7%. The protocol involved 11 acupoints on the abdomen (Guanyuan [RN4], Zhongwan [RN12] and Tianshu [ST25]), back (Pishu [BL20], Weishu [BL21], Sanjiaoshu [BL22], Shenshu [BL23], Qihaishu [BL24] and Dachangshu [BL25]), and limbs (Hegu [LI4] and Zusanli [ST36]). Table 1 presents the location and function of each acupoint. A detail demonstration video with a TCM practitioner showing the acupressure techniques (seated or supine position to accommodate users' preference; see Appendix

files 1 and 2) was provided to participants for their training. Participants (or caregivers) then performed acupressure at home twice daily for 10 consecutive days. For each acupoint, participants were instructed to apply pressure in a clockwise circular motion, making about 100 circles (1–2 times per second) and then to press the acupoint (with sufficient pressure to cause the fingernail bed to blanch) for two to three breath cycles (20–30 s). As instructed, one session of acupressure lasted about 15 min.

The control group performed a manual light touch on the abdomen in any direction or positions, guided by a researcher who was trained by a TCM practitioner with abdomen touching techniques. The practice frequency and duration (twice daily, 15 min/session for 10 consecutive days) were the same as the intervention group. Both groups received defecation education through a booklet developed by the research team with contents covering the concept of constipation and its causes, impacts, and preventive strategies (e.g., diet and exercise) [6,9].

2.5. Intervention fidelity and safety

Before performing acupressure, participants (or caregivers) received instructions on preparations and precautions, including practicing basic manual techniques using a pillow before applying them to the body. Video demonstrations provided professional instructions and detailed explanations for participants (or caregivers) to closely follow the correct acupressure procedure. Participants were provided with a diary to log their acupressure practice, which was scored as intervention adherence. A research assistant monitored participants' home practice by checking their diaries daily via WhatsApp to assess the intervention fidelity; during these check-ins the assistant collected questions or concerns related to acupressure from participants. The TCM practitioners provided professional feedback and support to participants for their acupressure-related questions throughout the study. Any adverse events occurring during the trial were handled cautiously and recorded.

Table 1
The specific location and function of acupoints.

Acupoint	Location	Function
RN4 (Guanyuan)	3 cun below the navel along the midline of abdomen	Promote yang qi of internal organs, and regulate spleen and stomach
RN12 (Zhongwan)	4 cun above the navel along the midline of abdomen	Adjust viscera qi and blood, invigorate spleen, and replenish qi
ST25 (Tianshu)	2 cun lateral to the navel	Relax large intestine, regulate qi, and eliminate stagnation
BL20 (Pishu), BL21 (Weishu), BL22 (Sanjiaoshu), BL23 (Shenshu), BL24 (Qihaishu), BL25 (Dachangshu)	1.5 cun lateral to the posterior midline, below the spinous processes from T11 to L4	BL20 and BL23 can help invigorate spleen and kidney; BL21 can establish harmony in stomach; BL22 can help to improve borborygmus and abdominal distension; BL24 and BL25 can improve abdominal distension and hemorrhoids
LI4 (Hegu)	Midpoint of the radial side of the second metacarpal bone	Clear heat, open orifices, promote gastrointestinal peristalsis, calm liver fire and relieve anger
ST36 (Zusanli)	4 finger-breadth below the tip of the kneecap, lateral to the bone ridge	Regulate spleen and stomach, and improve efficiency of qi and blood circulation

Cun: the unit of measurement for acupoints. One cun is equal to the width of the inter-phalangeal joint of the thumb.

2.6. Measures

A trained research assistant collected data at baseline (T0), post-intervention (T1), and one-month follow-up (T2). Sociodemographics (i.e., age, gender, marriage, education, employment and income), SCI injury history (i.e., cause, degree, type and duration), and daily water and fiber intake were evaluated.

2.6.1. Primary outcome

Constipation severity was assessed using the Constipation Assessment Scale with ratings from 0 (no problem) to 2 (severe problem) [34]. The total score 1–4, 5–9 and 10–16 suggests mild, moderate and sever constipation, respectively [35]. The Chinese language version demonstrated acceptable reliability (Cronbach's α = 0.79) [36]. Cronbach's α of the scale in this study is 0.71.

2.6.2. Secondary outcomes

Bowel habits were measured by the frequency of laxative and glycerine enema use and the frequency and duration of defecation in the past week [13].

Psychological well-being was evaluated by the Depression Anxiety Stress Scale to assess levels of depression, anxiety and stress [37]. Higher scores indicate lower psychological well-being with ratings on a 4-point Likert scale. The Chinese language version of the Depression Anxiety Stress Scale demonstrated good psychometric properties [38]. Cronbach's α of the scale in this study for depression, anxiety and stress is 0.86, 0.81 and 0.83, respectively.

Quality of life was assessed using the Patient Assessment of Constipation Quality of Life Questionnaire [39]. The scale includes four domains: physical discomfort, psychosocial discomfort, treatment satisfaction, and worries and discomfort. Higher scores indicate poorer quality of life with ratings from 0 (not at all) to 4 (extremely). The Chinese version demonstrated good reliability (Cronbach's α = 0.93) in the constipation population [40]. Cronbach's α of the scale in this study is 0.92.

2.6.3. Intervention feasibility and adherence

Intervention feasibility was assessed by recruitment period for a target sample size, recruitment rate (eligible participants who agreed to participate divided by all eligible subjects approached), and retention rate (participants who completed the study divided by participants who were allocated) [41]. Intervention adherence was assessed by reviewing participants' diaries which recorded daily practice time and frequency. Participants who completed at least half of the ten-day program were considered valid and included in data analysis. Participants in the intervention group who improved most and least from T0 to T1 in constipation severity were invited to join online focus group interviews after T1. Four to five participants with consent and diverse characteristics (i.e., gender, SCI degree, and constipation severity changes) formed the post-treatment focus group. Interviews were conducted with the focus group to understand their perception of bowel management and well-being, as well as strengths, limitations and recommendations of the intervention.

2.7. Data analysis

Quantitative data were analyzed using IBM SPSS 26 (IBM Corp, Armonk, NY), R 4.3.1 (R Development Core Team, Vienna), and RStudio 2023.06.2+561 (Posit Software, PBC, Vienna). Intention-to-treat analysis was conducted. The method for handling missing data was not needed in this study as there were no dropouts for

outcome assessments and there was a high response rate for online questionnaires. Intervention effects were estimated using the generalized estimating equation model, controlling for covariates identified by randomized testing between groups at baseline ($P < 0.05$) [42]. Randomized testing included *t*-tests for continuous data with a normal distribution, Mann–Whitney *U* tests for continuous data with a skewed distribution, and Chi-square tests for categorical data. Group differences in changes in the frequency of laxative and glycerin enema use were compared using the Mann-Whitney *U* test due to their skewed distribution. Cohen's *d* was used for effect size estimation [43]. Subgroup analysis was performed between self-administered and caregiver-assisted acupressure. Tape-recorded interviews were transcribed for analysis. Qualitative data were analyzed for content [44] by two authors (ML and TCS) working independently. This analysis relied on four steps: reading transcripts repeatedly, identifying meaningful units, generating codes by condensing similar meaningful units, and sorting the codes into categories. Discrepancies in assignment of codes and categories were discussed and finally confirmed by the team.

3. Results

3.1. Participant flow and adherence

Recruitment occurred from March to November 2023. Follow-up was completed in February 2024. Fig. 1 shows the study flowchart. Of the eighty-three eligible patients, eighty were allocated to study groups (recruitment rate 96.4%), and all participants completed the study (retention rate 100%). Regarding the adherence of the intervention and control groups, 94.5% and 90.4% completed required practice days, 73.4% and 65.0% completed twice-daily sessions, and average practice time per session was 14.70 (standard deviation [SD] = 4.66) and 13.25 (SD = 4.10) min, respectively. No significant group differences were present. No intervention-related adverse events were reported.

3.2. Baseline

Table 2 displays participant characteristics. Of the 80 participants, the mean age was 57.8 (SD = 9.5) years; 58.8% were female; and 72.5% were unemployed. The majority had incomplete SCI (73.8%) and paraplegia (83.8%). The interquartile range of post-SCI years was 25 (11, 48). Participants had moderate constipation (mean = 5.6), with 70% experiencing less than daily defecation and 42.5% reporting a defecation time exceeding 30 min. In the week before enrolment, 41.3% and 55.0% of all participants had used laxatives or glycerine enemas, respectively. Participants reported moderate anxiety (median = 10), mild depression (median = 10), and normal stress (median = 14). The average quality of life score was 39.7 (SD = 16.6). No significant group differences were found at baseline.

3.3. Effectiveness

Table 3 presents the intervention effects. The subgroup analysis between self-administered and caregiver-assisted (three in the intervention and two in the control group) participants did not find statistically significant differences.

3.3.1. Primary outcome

A significant group-by-time interaction effect for constipation severity was present ($P = 0.005$). The intervention showed significant between-group improvements on constipation severity at T2, with a large effect size (Cohen's $d = 0.95$).

3.3.2. Secondary outcomes

Significant group effects were found for anxiety ($P = 0.020$) and depression ($P = 0.005$). The intervention showed significant between-group improvements on anxiety and depression at T1, both with a medium effect size (Cohen's $d = 0.69$ and 0.72, respectively).

Significant group-by-time interaction effects for the overall quality of life and its four domains were present ($P < 0.05$). The intervention showed significant between-group improvements on the overall quality of life and its domains of physical discomfort and psychological discomfort both at T1 and T2, with medium-to-large effect sizes (Cohen's $d = 0.67–1.07$). The intervention also showed significant between-group improvements on two other domains of quality of life at T2, with large effect sizes (Cohen's $d = 1.01$ and 0.90). The intervention group reported significantly reduced glycerine enema use ($P = 0.015$; Table 4).

3.4. Qualitative results

Table 5 shows thirteen interviewees' characteristics in three focus groups. Three main categories were identified as follows.

3.4.1. Category 1: Improvements in bowel function and management

Enhanced bowel movement: participants perceived enhanced bowel movement and easier expulsion of gas and waste after performing acupressure. "After performing acupressure, I can feel intestine movements and easier expulsion of gas" (G2P1, tetraplegia, complete SCI). "I feel that acupoint massage can help stimulate the bowel movement to expel the waste inside" (G3P5, tetraplegia, incomplete SCI).

Satisfied defecation experience: participants felt satisfied with defecation due to a smoother experience and less discomfort after using acupressure for consecutive days. "If pressing the acupoints, it will be easier to defecate and less discomfort" (G3P2, paraplegia, incomplete SCI). "I found that after acupressure for 2 or 3 days, it was smoother to expel stool" (G1P2, paraplegia, incomplete SCI).

Improved bowel management skills: participants improved constipation management skills by using acupressure and increasing water intake. "Acupressure is good and I continue it. There is a mindset change that I don't rely on medications for constipation" (G1P2, paraplegia, incomplete SCI). "When I drank more water and did acupressure, passing stools became easier" (G3P2, paraplegia, incomplete SCI).

3.4.2. Category 2: Reduced psychological distress following relief from constipation

Fewer worries about defecation: participants reported fewer worries about defecation and a better mood. "Since I performed acupressure, I have more confidence on defecation and a better mood" (G2P4, paraplegia, incomplete SCI). "My worries have been reduced due to smoother defecation" (G3P5, tetraplegia, incomplete SCI).

Improved mood: participants felt relaxed and happier after their constipation was relieved. "Smoother defecation makes me more relaxed and happier. I'll naturally want to eat now" (G3P2, paraplegia, incomplete SCI). "Time for defecation is shorter after acupressure. I can sleep longer which makes me happy" (G3P5, tetraplegia, incomplete SCI).

Release from defecation-related embarrassment: participants experienced relief due to improved control over their defecation. "I am less embarrassed when I go back to work. I have better control over defecation now" (G3P5, tetraplegia, incomplete SCI). "After performing acupressure, I have a morning routine for defecation, making me more at ease when going out" (G1P2, paraplegia, incomplete SCI).

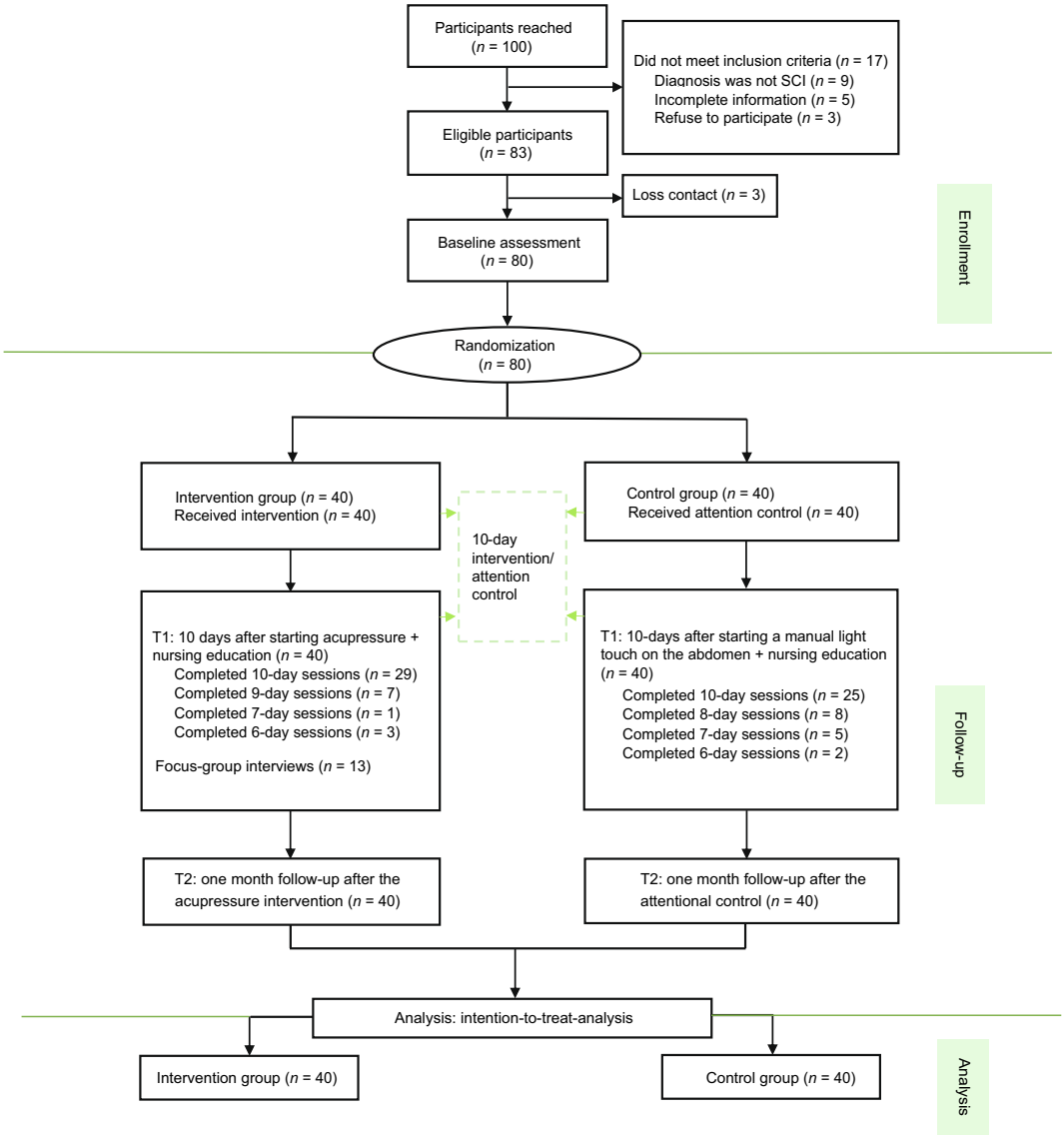

Fig. 1. Study flowchart. SCI: spinal cord injury.

3.4.3. Category 3: Acceptability of home-based acupressure

Satisfaction with acupressure: participants were satisfied with acupressure and video demonstrations, finding them easy to practice and beneficial for health. "Acupressure allows me to fully expel stool and feel better mentally. It's easy to practice without much effort" (G3P1, paraplegia, complete SCI). "I can watch videos again if uncertain. It is clearly explained" (G1P2, paraplegia, incomplete SCI).

Challenges with acupressure: participants with tetraplegia had difficulty with acupressure due to limited finger dexterity and sensation. "I have difficulties due to limited finger dexterity. I often rely on pressing with the bone of my finger" (G3P5, tetraplegia, incomplete SCI). "Some positions are quite strenuous due to my physical condition. I'm uncertain about the intensity" (G2P1, tetraplegia, complete SCI).

Intervention recommendations: participants suggested the use of tools to assist with acupressure and having in-person sessions and regular practice in an online group. "It's uncertain if we can achieve desired effect with finger strength. Some tools may be introduced" (G2P2, paraplegia, incomplete SCI). "How about some in-person sessions? Sometimes we may doubt that we performed it correctly" (G3P3, paraplegia, incomplete SCI). "It will be more motivating in a group, like using Zoom to regularly practice together" (G2P3, tetraplegia, complete SCI).

4. Discussion

This trial, to our knowledge, was the first study evaluating the effectiveness of home-based acupressure on constipation and subjective well-being in SCI survivors. Participants reported moderate constipation and difficulty defecating at baseline. This short-term acupressure program outperformed the control group for improving constipation, anxiety, depression, and quality of life with moderate-to-large effect sizes. Qualitative findings supported the intervention's acceptability and positive outcomes.

The severity of constipation reported by our participants with SCI (mean = 5.60) was greater than is typical for healthy adults (mean = 1.51) [45]. At baseline, the majority of participants reported a low defecation frequency and close to half required a long time to defecate, aligning with earlier studies [13]. Constipation among this population is primarily attributed to damage to the nerves that control bowel function, accompanied by physical

Table 2
Participant characteristics at baseline.

Item	Total (n = 80)	Intervention (n = 40)	Control (n = 40)	$t/Z/c^2$ value	P value
Age (mean ± SD, years old)	57.8 (9.5)	57.7 (9.9)	57.9 (9.2)	–0.070[a]	0.944
Gender (n [%])				0.052	0.820
Male	33 (41.3)	17 (42.5)	16 (40.0)		
Female	47 (58.8)	23 (57.5)	24 (60.0)		
Marriage (n [%])				1.875	0.171
Single	32 (40.0)	13 (32.5)	19 (47.5)		
Married	48 (60.0)	27 (67.5)	21 (52.5)		
Education (n [%])				1.531	0.465
Primary school	18 (22.5)	8 (20.0)	10 (25.0)		
Secondary school	51 (63.7)	28 (70.0)	23 (57.5)		
College or above	11 (13.8)	4 (10.0)	7 (17.5)		
Employment (n [%])				1.276	0.528
Full-time	6 (7.5)	3 (7.5)	3 (7.5)		
Part-time	16 (20.0)	10 (25.0)	6 (15.0)		
Unemployed	58 (72.5)	27 (67.5)	31 (77.5)		
Household monthly income (HK$, n [%])				9.019	0.108
Social security assistance[c]	20 (25.0)	11 (27.5)	9 (22.5)		
$4000 or below	18 (22.5)	7 (17.5)	11 (27.5)		
$4000–$9999	15 (18.7)	5 (12.5)	10 (25.0)		
$10,000–$19,999	19 (23.8)	14 (35.0)	5 (12.5)		
$20,000 or above	8 (10.0)	3 (7.5)	5 (12.5)		
SCI cause (n [%])				3.232	0.072
Traumatic	44 (55.0)	26 (65.0)	18 (45.0)		
Non-traumatic	36 (45.0)	14 (35.0)	22 (55.0)		
SCI degree (n [%])				0.065	0.799
Complete	21 (26.3)	10 (25.0)	11 (27.5)		
Incomplete	59 (73.8)	30 (75.0)	29 (72.5)		
SCI type (n [%])				0.092	0.762
Tetraplegia	13 (16.2)	6 (15.0)	7 (17.5)		
Paraplegia	67 (83.8)	34 (85.0)	33 (82.5)		
Years post-SCI (median [P_{25}, P_{75}])	25 (11, 48)	25 (12, 52)	25 (11, 47)	–0.520[b]	0.603
Constipation severity[1] (mean ± SD)	5.6 (2.8)	5.6 (3.1)	5.6 (2.5)	0[a]	1
Daily water intake (n [%])				0.205	0.651
< 1500 mL	34 (42.5)	16 (40.0)	18 (45.0)		
≥ 1500 mL	46 (57.5)	24 (60.0)	22 (55.0)		
Daily fiber intake (n [%])				0.238	0.626
< 6 taels[d] of vegetables	56 (70.0)	27 (67.5)	29 (72.5)		
≥ 6 taels of vegetables	24 (30.0)	13 (32.5)	11 (27.5)		
Frequency of defecation (n [%])				2.487	0.288
Every day	24 (30.0)	15 (37.5)	9 (22.5)		
2–6 times a week	50 (62.5)	23 (57.5)	27 (67.5)		
Less than once a week	6 (7.5)	2 (5.0)	4 (10.0)		
Defecation time (n [%])				1.127	0.569
30 min or below	46 (57.5)	24 (60.0)	22 (55.0)		
31–60 min	25 (31.2)	13 (32.5)	12 (30.0)		
60 min or above	9 (11.3)	3 (7.5)	6 (15.0)		
Use of laxatives (≥ 1 time/week, n [%])	33 (41.3)	17 (42.5)	16 (40.0)	0.052	0.820
Use of glycerine enema (≥ 1 time/week, n [%])	44 (55.0)	22 (55.0)	22 (55.0)	0	1
Psychological well-being (median [P_{25}, P_{75}])					
Anxiety[2]	10 (4.5, 16)	8 (2.5, 15.5)	11 (6, 16)	0.929	0.353
Depression[3]	10 (2, 14)	7 (2, 13.5)	10 (2, 16)	0.645	0.519
Stress[4]	14 (8, 18)	14 (8, 18)	13 (8, 18)	–0.111	0.912
Quality of life (mean ± SD)					
Total score (0–112)	39.7 (16.6)	39.4 (17.6)	40.1 (15.7)	–0.188	0.852
Physical discomfort (0–16)	4.4 (2.8)	4.5 (2.9)	4.4 (2.8)	0.157	0.876
Psychosocial discomfort (0–32)	7.9 (5.9)	8.1 (6.0)	7.8 (6.0)	0.242	0.810
Treatment satisfaction (0–20)	12.3 (3.6)	11.6 (3.7)	13.10 (3.3)	–1.945	0.055
Worries and discomfort (0–55)	15.0 (8.1)	15.2 (8.6)	14.8 (7.6)	0.221	0.826

SCI: spinal cord injury; SD: standard deviation.
[a] t value.
[b] Z value, and the else statistics are χ^2 value.
[c] The financial support for single persons or family cases with disabilities or those requiring constant care, provided they meet the asset limits set by the government of the Hong Kong Special Administrative Region.
[d] 1 tael = 37.7994 g.
[1] Range 0–16; mild 1–4, moderate 5–9, and severe 10–16.
[2] Range 0–42; normal 0–7, mild 8–9, moderate 10–14, severe 15–19, and extremely severe 20+.
[3] Range 0–42; normal 0–9, mild 10–13, moderate 14–20, severe 21–27, and extremely severe 28+.
[4] Range 0–42; normal 0–14, mild 15–18, moderate 19–25, severe 26–33, and extremely severe 34+.

inactivity and psychosocial stressors [6]. The home-based acupressure did not cause any adverse events. It had high adherence for the duration of acupressure, but a lower compliance for the frequency of twice daily. This finding was similar to self-administered acupressure conducted in adults with probable knee osteoarthritis [24]. Our qualitative data revealed that video guid-

Table 3
Intervention effects by group assignment across time using generalized estimating equations.

Measure	Score (mean [SE])/(*n* [%])			Test of adjusted model effects (Wald χ^2 [*P*])			Between-group comparison	
	T0	T1	T2	Time	Group	Group-by-time	T1	T2
Constipation severity				0.135 (0.935)	11.521 (**0.001**)	10.669 (**0.005**)	MD: −1.48; *P*: 0.322; ES (95% CI): −0.52 (−0.96, 0.07)	MD: −2.78; *P*: **< 0.001;** ES (95% CI): −0.95 (−1.41, −0.49)
Intervention group	5.60 (0.48)	4.73 (0.48)	4.10 (0.40)					
Control group	5.60 (0.38)	6.20 (0.43)	6.88 (0.53)					
Psychological well-being								
Anxiety				3.826 (0.148)	5.398 (**0.020**)	3.592 (0.166)	MD: −3.95; *P*: **0.036**; ES (95% CI): −0.69 (−1.14, −0.24)	MD: −2.05; *P*: 1.000; ES (95% CI): −0.35 (−0.79, 0.09)
Intervention group	10.05 (1.22)	7.20 (0.71)	7.90 (0.92)					
Control group	11.40 (1.20)	11.15 (1.09)	9.95 (0.96)					
Depression				0.079 (0.961)	7.847 (**0.005**)	3.425 (0.180)	MD: −5.35; *P*: **0.022**; ES (95% CI): −0.72 (−1.17, −0.27)	MD: −4.15; *P*: 0.351; ES (95% CI): −0.51 (−0.96, −0.07)
Intervention group	9.05 (1.13)	7.50 (1.09)	8.05 (1.34)					
Control group	10.75 (1.44)	12.85 (1.28)	12.20 (1.25)					
Stress				1.497 (0.473)	3.089 (0.079)	4.371 (0.112)	MD: −2.90; *P*: 1.000; ES (95% CI): −0.39 (−0.83, 0.05)	MD: −4.40; *P*: 0.240; ES (95% CI): −0.54 (−0.99, −0.10)
Intervention group	13.80 (1.34)	11.25 (1.14)	10.60 (1.40)					
Control group	13.80 (1.23)	14.15 (1.25)	15.00 (1.18)					
Quality of life								
Total score				2.070 (0.355)	14.670 (< **0.001**)	13.230 (**0.001**)	MD: −10.93; *P*: **0.005**; ES (95% CI): −0.81 (−1.26, −0.35)	MD: −16.65; *P*: **< 0.001**; ES (95% CI): −1.07 (−1.54, −0.60)
Intervention group	39.35 (2.74)	32.10 (2.03)	31.78 (2.38)					
Control group	40.05 (2.45)	43.03 (2.29)	48.43 (2.60)					
Physical discomfort				1.616 (0.446)	8.196 (**0.004**)	8.581 (**0.014**)	MD: −1.73; *P*: **0.015**; ES (95% CI): −0.74 (−1.20, −0.29)	MD: −1.83; *P*: **0.036**; ES (95% CI): −0.70 (−1.15, −0.24)
Intervention group	4.45 (0.45)	3.83 (0.36)	3.32 (0.39)					
Control group	4.35 (0.44)	5.55 (0.38)	5.15 (0.45)					
Psychosocial discomfort				1.416 (0.493)	9.973 (**0.002**)	12.472 (**0.002**)	MD: −2.83; *P*: **0.046**; ES (95% CI): −0.67 (−1.12, −0.22)	MD: −4.90; *P*: < **0.001**; ES (95% CI): −0.96 (−1.43, −0.50)
Intervention group	8.10 (0.93)	5.70 (0.66)	5.35 (0.72)					
Control group	7.78 (0.94)	8.53 (0.69)	10.25 (0.90)					
Treatment satisfaction				4.329 (0.115)	17.297(< **0.001**)	6.344 (**0.042**)	MD: −2.45; *P*: 0.057; ES (95% CI): −0.66 (−1.11, −0.21)	MD: −3.63; *P*: **< 0.001**; ES (95% CI): −1.01 (−1.48, −0.54)
Intervention group	11.58 (0.57)	10.73 (0.56)	11.05 (0.60)					
Control group	13.10 (0.52)	13.18 (0.63)	14.68 (0.55)					
Worries and discomfort				3.112 (0.211)	8.104 (**0.004**)	10.306 (**0.006**)	MD: −3.93; *P*: 0.080; ES (95% CI): −0.63 (−1.08, −0.18)	MD: −6.30; *P*: **0.001**; ES (95% CI): −0.90 (−1.36, −0.44)
Intervention group	15.23 (1.34)	11.85 (0.93)	12.05 (1.16)					
Control group	14.83 (1.18)	15.78 (1.06)	18.35 (1.08)					
Frequency of defecation[a]				0.535 (0.765)	3.203 (0.074)	0.019 (0.990)	–	–
Intervention group	15 (37.5)	13 (32.5)	13 (32.5)					
Control group	9 (22.5)	8 (20.0)	8 (20.0)					
Defecation time[b]				0.742 (0.690)	3.373 (0.066)	0.963 (0.618)	–	–
Intervention group	24 (60.0)	25 (62.5)	24 (60.0)					
Control group	22 (55.0)	18 (45.0)	17 (42.5)					

CI: confidence interval; ES: effect size (Cohen's *d*, small effect 0.2, medium effect 0.5, large effect 0.8); MD: mean difference; SE: standard error; T0: baseline; T1: post-intervention; T2: one-month follow-up.
[a] Frequency of defecation: every day (*n* [%]).
[b] Defecation time: 30 min or below (*n* [%]).

ance and benefits of the intervention contributed to its acceptability. Participants also recommended online group sessions to improve engagement in regular practice. Home-based acupressure offers a feasible, acceptable and safe treatment for SCI survivors with constipation.

Participants reported a decrease in constipation severity on a post-intervention questionnaire, with a significant large effect size improvement persisting through the 1-month follow-up. This positive finding aligns with the effect of clinic-based acupressure for stroke patients [22] and self-administered acupressure for

Table 4
Intervention effects on bowel habits by group assignment.

Measure	Intervention (n = 40)	Control (n = 40)	Z value	P value
Frequency of laxative use (median [P_{25}, P_{75}])				
T1–T0[1]	0 (−1.0, 0.75)	0 (0, 3)	1.945	0.052
T2–T0[2]	0 (−1.0, 0)	0 (−1, 2)	1.253	0.210
Frequency of glycerine enema use (median [P_{25}, P_{75}])				
T1–T0[1]	0 (−2, 1.75)	1 (0, 3.75)	2.427	0.015
T2–T0[2]	0 (−0.75, 1.75)	0 (−1, 2)	−0.163	0.870

[1] The difference of frequency of laxative/glycerine enema use in the past week between T1 and T0.
[2] The difference of frequency of laxative/glycerine enema use in the past week between T2 and T0.

Table 5
Focus group interviewee's characteristics.

Group	Interview time (min)	Case No.	Gender	SCI degree	SCI type	Years post-SCI	Constipation severity difference[a]
Group 1	78	G1P1[b]	Female	Incomplete	Paraplegia	7	−8
		G1P2	Female	Incomplete	Paraplegia	8	7
		G1P3	Female	Complete	Paraplegia	19	7
		G1P4	Male	Complete	Paraplegia	6	−9
Group 2	71	G2P1	Male	Complete	Tetraplegia	18	2
		G2P2	Male	Incomplete	Paraplegia	48	−2
		G2P3	Female	Complete	Tetraplegia	10	−6
		G2P4	Female	Incomplete	Paraplegia	8	3
Group 3	60	G3P1	Male	Complete	Paraplegia	44	0
		G3P2	Female	Incomplete	Paraplegia	61	1
		G3P3	Male	Incomplete	Paraplegia	59	4
		G3P4	Female	Incomplete	Paraplegia	19	5
		G3P5	Female	Incomplete	Tetraplegia	25	2

SCI: spinal cord injury.
[a] The value of constipation severity assessed by the Constipation Assessment Scale at post-intervention minus the value at baseline.
[b] Caregiver-assisted acupressure.

psychiatric patients [23]. TCM meridian theory suggests that pressure along meridian-positioned acupoints can stimulate the flow of Qi (the energy that restores equilibrium within the body) and blood, thereby regulating visceral functions [20]. Evidence suggests that stimulating acupoints like Zusanli (ST36) and Zhongwan (RN12) can trigger a vagal nerve response, leading to enhanced parasympathetic activity and improved bowel function [46]. Similarly, electroacupuncture at abdominal acupoints can increase intestinal motility by altering the enteric nervous system, such as triggering M3 receptors and afferent nerve [47]. This intervention also showed significant improvements in reduced enema use, supported by both quantitative and qualitative findings.

The intervention showed immediate and significant improvement in anxiety and depression with a moderate effect size. The positive psychological effects might be related to the relief of constipation symptoms, as constipation is significantly associated with depression among SCI survivors [12]. Our qualitative findings also suggest that SCI individuals experience reduced psychological distress (e.g., fewer worries) following relief from constipation. Another potential explanation might be linked to the role of Hegu (LI4) and Zusanli (ST36) in relieving anxiety and depression, which has been shown in patients with cancer or undergoing hemodialysis [48,49]. Hegu (LI4) and Zusanli (ST36) are commonly treated help ease anger and depression, in accordance to TCM meridian theory. A neural study suggests that stimulating Hegu (LI4) through electroacupuncture reduces neuronal apoptosis (a contributing factor of depression) [50], while stimulating Zusanli (ST36) links to c-Fos expression (a biomarker of anxiety) [51].

This program yielded significant, immediate and sustained improvements with a large effect size in quality of life of patients, consistent with the effects of self-administered acupressure in psychiatric patients with constipation [23]. This study specifically found that acupressure can improve physical and psychological well-being in the short-term, and that these improvements persisted following the relief of constipation. These positive associations align with earlier studies and our qualitative findings, which highlighted that individuals perceived less constipation-related physical discomfort and experienced less embarrassment around defecation after the acupressure intervention [52]. Additionally, study participants had significant improvements in treatment satisfaction and reduced worries at the one-month follow-up, which were also supported by the focus group interviews. These data suggest that home-based acupressure can provide a satisfying treatment option for SCI survivors, with prolonged effects for improving bowel function and relieving concerns about constipation.

Several limitations should be acknowledged. The short follow-up period limited the evaluation of long-term intervention effects. Self-reported measurements may increase the risk of reporting bias. Although participants received specific instructions about applying acupressure, the lack of objective measurements for grip strength introduce variability in how the treatments were applied, potentially influencing the effectiveness of the therapy. Nevertheless, this study provides novel evidence that acupressure can be learned and self-administered in home settings to effectively treat constipation among SCI survivors who face mobility challenges. The findings highlight the potential of home-based acupressure for reducing the burden on healthcare workers. Introducing tools to assist with self-administered acupressure, in-person sessions, and online group practice are also recommended by this study to address barriers and enhance engagement in acupressure.

5. Conclusion

The home-based acupressure program is an acceptable and safe therapy approach for individuals with SCI to help manage their constipation. Participants experienced significant improvements in constipation severity, psychological well-being, and quality of life. SCI survivors are recommended to use this home-based acupressure intervention for their long-term management of constipation.

CRediT authorship contribution statement

All authors contributed to the conceptualization and methodology of this study. **ML**, **YL** and **JL** contributed to the formal analysis. **WL**, **WFY**, **YSH**, **SY** and **YH** contributed to its validation. **YL**, **WL** and **JY** contributed to the supervision. **TCS** contributed to the investigation. **ML** and **YL** drafted the initial version of the manuscript. All authors critically reviewed and revised the manuscript and approved the manuscript for submission.

Funding

This study was funded by the Chinese Medicine Development Fund (Project No. 20B/033A).

Acknowledgments

We would like to thank the TCM practitioner Mr. Michael W.Y. Chung for demonstrating the acupressure practice and the data analyst Ms. Mengting He in data analysis support.

Declaration of competing interest

All the authors in this article declare that they have no competing interests.

Appendix A. Supplementary material

Supplementary material to this article can be found online at https://doi.org/10.1016/j.joim.2025.08.001.

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