



BMJ Open Protocol for a single group, mixed methods study investigating the efficacy of photovoice to improve self-efficacy related to balance and falls for spinal cord injury

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ABSTRACT

Introduction Many individuals living with spinal cord injury (SCI) experience falls and a fear of falling, both of which can impact participation in daily activities and quality of life. A single group, convergent mixed methods study will be conducted to examine the effects of a photovoice intervention on falls self-efficacy among individuals living with chronic SCI. Secondary objectives include examining the effects of photovoice on fear of falling, participation and quality of life and exploring participants' experiences and perceptions of the photovoice intervention through qualitative interviews. **Methods and analysis** Adults with SCI (n=40) will be divided into groups according to their mobility status (ie, those who ambulate and those who primarily use a wheelchair). The study will be conducted virtually over three consecutive phases, totalling 30 weeks. Each group will self-report falls for 12 weeks prior to and following the intervention (phases 1 and 3, respectively). The 6-week photovoice intervention (phase 2) will be comprised of two photo assignments, two individual interviews with a researcher and a peer mentor, and four group meetings. Participants will discuss these photos at the interviews and group meetings. Standardised questionnaires of falls self-efficacy, fear of falling, participation and life satisfaction will be administered at four time points (ie, beginning of each phase and the end of phase 3). Questionnaire scores will be examined over time using repeated-measures analysis of variance. A semistructured interview will be completed at the end of phase 3 to gain feedback on the photovoice intervention. Qualitative data will be analysed using reflexive thematic analysis.

Ethics and dissemination Ethics approval was obtained prior to study enrolment. Findings will be shared through peer-reviewed scientific publications and participant-directed knowledge translation activities.

Trial registration number NCT04864262.

INTRODUCTION

Falls are a public health issue that comes with significant cost to the healthcare system.¹ A fall is commonly defined as an event where

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ The intervention is theory-based and informed by recommendations for falls-related interventions from people with spinal cord injury, such as the involvement of peer mentors.
- ⇒ The virtual delivery of the intervention enhances participation of individuals with spinal cord injury from across Canada and the USA.
- ⇒ The mixed methods design allows for integration of quantitative and qualitative findings, which will inform improvements for future photovoice interventions.
- ⇒ The lack of a control group limits the interpretation of the data and precludes conclusions about causation.

one comes to rest inadvertently on a lower level.² People with spinal cord injury (SCI) experience higher rates of falls than do older able-bodied adults or individuals with other neurological conditions.^{3–6} The causes and circumstances of falls for people with SCI are multifactorial⁷ and vary between those who ambulate and those who use a wheelchair. For example, wheelchair users commonly fall in the afternoon or evening when transferring, reaching or propelling on uneven surfaces, while those who ambulate commonly fall in the mornings or afternoons when walking, standing or changing positions (eg, sitting to standing).⁸ However, all people with SCI, regardless of mobility status, may experience significant physical, psychosocial and economic impacts from falling and/or living with a high fall risk.^{9–11}

One such impact of falling has been referred to as post-fall syndrome, which is characterised by loss of autonomy, reduced mobility, activity restriction and depression.¹² Post-fall syndrome has been described as

the result of a positive feedback loop between disturbed balance and falls.¹³ However, behaviours like restricting mobility and avoiding activities have also been observed in people with SCI who have not fallen, but have a fear of falling.¹⁴ A fear of falling is a lasting concern about falling that causes one to avoid activities that they are capable of performing.¹⁵ It is estimated that 50%–73% of people with SCI have this fear.^{16–20} A fear of falling is a psychological construct that is sometimes used interchangeably with the construct falls self-efficacy, but they are distinct from one another. Fear of falling is conceptualised as having three components: physiological (eg, autonomic response), behavioural (eg, reducing speed or avoiding activities) and cognitive (eg, estimating the risk of falling or confidence to avoid falling).²¹ Falls self-efficacy, or the ‘perceived self-confidence at avoiding falls during essential, relatively non-hazardous activities’,¹⁵ is most similar to the cognitive dimension of fear of falling, as both are beliefs about falls. Both falls self-efficacy and fear of falling provide unique utility in the prediction of balance performance and falls, and there is some evidence that falls self-efficacy is a mediator between fear of falling and falls.²²

The delivery of fall prevention education and training is a required organisational practice at hospitals involved with SCI rehabilitation.²³ Despite this requirement, fall prevention initiatives were deemed inadequate by healthcare administrators,²⁴ physical and occupational therapists²⁵ and individuals with SCI.^{7 26} Fall prevention in the form of balance exercises is implemented during SCI rehabilitation, yet little time is spent on this intervention. Individuals with incomplete SCI, on average, receive only 2.0±2.0 hours of balance training during their *entire* inpatient stay.²⁷ In addition to balance exercises, people living with SCI have highlighted the need for comprehensive education concerning the environmental contributors to falls and how to advocate for the removal of environmental hazards.^{28 29} The lack of comprehensive and relevant fall prevention education and training in SCI rehabilitation likely reflects the lack of evidence-based interventions.^{24 30 31} Similarly, the interventions addressing fear of falling in people with neurological disease are few in number and low in methodological rigour.³² In our prior research exploring fall education and training needs,^{28 29} individuals living with SCI identified components they would like to see in fall prevention initiatives:

- ▶ *SCI-specific* information about falls, fall risk factors and strategies to avoid falls and minimise injury, rather than generic fall prevention information.
- ▶ *Individualised* education and training that reflects each individual’s unique fall risk factors.
- ▶ *Adaptable* education and training that is appropriate for their dynamic needs and life circumstances.
- ▶ *Online* initiatives to increase accessibility to education and training.
- ▶ *Involvement of peers*, along with health professionals, in the delivery of fall prevention initiatives.

To address the need for effective fall prevention initiatives tailored to the SCI population, we will study the efficacy of a novel intervention, photovoice, to improve falls self-efficacy. Prior research has used photovoice, a participatory research method, to understand the causes, consequences, management and prevention of falls and fall risk after SCI.^{28 29} Photovoice enables participants to be actively involved in the research process, and results in detailed insight into their perspectives on an issue.^{33 34} It uses photographs, interviews and group discussion to explore a group’s strengths and concerns, and enables participants to transfer their own experiences and knowledge to action. It is the inclusion of photography that makes photovoice unique from other interventions using group-based discussion. Photos act as ‘communication bridges’ during group discussion, enabling individuals to tell their stories spontaneously.³⁵ While photovoice is an emerging methodology in health-related research,³⁶ photovoice is also a process that can increase self-efficacy in health and social domains.^{37 38} In our prior work, photovoice enabled individuals living with SCI to self-reflect on the strategies that reduced their individual fall risk and to share their experiences, knowledge and strategies with peers.^{28 29} Moreover, self-efficacy theory, as outlined below, suggests that as confidence about preventing a fall increases, associated behaviours (eg, reduced participation) change.³⁹ If participation is increased, self-reported quality of life may increase as well, as higher levels of participation are associated with greater life satisfaction among community-dwelling individuals with SCI.⁴⁰ Thus, a photovoice intervention may address a number of the negative sequelae of falls and fall risk after SCI.

The primary theoretical framework used in the present study is the agency aspect of Bandura’s Social Cognitive Theory (SCT).⁴¹ Broadly, SCT considers the reciprocal interactions between individuals, their environment and their behaviour. Social influence, past behaviour and self-efficacy are also considered in the study of maintaining behavioural action. Based on SCT, improved falls self-efficacy should translate to increased participation as conceptualised by the International Classification of Functioning, Disability, and Health (ICF). According to SCT, there are numerous means of increasing self-efficacy and the photovoice intervention is expected to operate through three of these: vicarious experience, verbal persuasion and direct/mastery experience.^{39 41} To explain further, during the photovoice intervention, participants will discuss strategies that they have used to reduce falls in a group format with ‘like others’ (ie, participants and peer mentors with SCI). This represents both vicarious experience and verbal persuasion contributing to increasing self-efficacy. As falls self-efficacy increases, SCT suggests that participation may increase. This relationship is theorised to be reciprocal, such that successful participation should further contribute to increased self-efficacy. This represents the third source of increased self-efficacy: direct/mastery experience.

Here, we describe the protocol for a single group, mixed methods study. The primary objective is to evaluate the effects of photovoice on falls self-efficacy among two groups of individuals living with SCI: those who ambulate and those who use a wheelchair as their primary means of mobility. It is hypothesised that scores on questionnaires of falls self-efficacy will significantly improve, and that qualitative perspectives from participants, collected through semistructured interviews, will corroborate these findings. Secondary objective one is to evaluate the effects of photovoice on fear of falling, quality of life and level of participation among individuals with SCI who ambulate and those who use a wheelchair. It is hypothesised that scores on questionnaires of fear of falling, quality of life and participation will significantly improve, and that qualitative feedback from participants will corroborate these findings. Secondary objective two is to explore the participants' experiences with, and perceptions of, the photovoice intervention via qualitative interviews. This will provide insight into improvements that can be made to future photovoice interventions.

METHODS AND ANALYSIS

Study design

This Phase 2a proof of concept study⁴² will be conducted using a convergent mixed methods design, which is used when the quantitative and qualitative strands are independent from one another.⁴³ The quantitative component will follow a pre–post design, while the qualitative component will follow a qualitative descriptive design. Following analysis of the data in both study strands, the quantitative and qualitative results will be integrated to corroborate evidence and produce a more complete understanding of the effects of photovoice (figure 1). The study start date was 27 September 2021, and the estimated end date is 31 March 2024. The Standard Protocol Items: Recommendations for Interventional Trials guided the reporting of the trial protocol.^{44 45}

The study will be conducted over three consecutive phases, totalling 30 weeks (table 1 and figure 1). Phase 1 will last for 12 weeks, over which falls will be tracked. Phase 2 will consist of a 6-week photovoice intervention. Phase 3

will involve falls tracking for 12 weeks and an individual, semi-structured interview at the end. Questionnaires querying falls self-efficacy, fear of falling, participation and life satisfaction will be completed at four time points (table 1). All study activities will be completed through a web conferencing platform (Microsoft Teams) except where technical difficulties (eg, compromised internet connection) require use of the telephone.

Participants

Participants will be adults (ie, ≥ 18 years of age) living with traumatic or non-traumatic and non-progressive SCI for >12 months, with a rating of A–D on the American Spinal Injury Association Impairment Scale (AIS), as per self-report.⁴⁶ As participants may be unsure of the rating of their SCI on the AIS, a researcher will ask standardised questions about the individual's sensory and motor function in order to describe the SCI as motor incomplete, sensory incomplete or complete.⁴⁷ Participants will be living in the community, report experiencing at least one fall since sustaining their SCI, be free of other conditions beside SCI that affect balance (eg, vestibular disorder), understand spoken English, and have access and the ability to use the internet. Participants will include those who walk and those who primarily use a wheelchair (ie, use a wheelchair to mobilise at least 4 hours/day).⁴⁸ A total of 40 participants will be recruited; 20 who use a wheelchair and 20 who ambulate. The targeted sample size was calculated using G*Power.⁴⁹ Previously collected data from questionnaires of balance confidence (ie, Activities-specific Balance Confidence (ABC) Scale and WheelCon) were used to inform the estimated effect sizes of 0.3.^{8 19} The sample size calculation in G*Power was performed considering that a repeated-measures analysis of variance (ANOVA) will be used to evaluate the effects of photovoice on balance confidence (ie, test family=F tests, statistical test=ANOVA: repeated measures, within factors). Power was set to 80% and alpha=0.05. The resulting sample size for each group was 17 participants. To account for the possibility of attrition, 20 participants who ambulate and 20 who use a wheelchair will be recruited. We expect these sample sizes to be adequate for the qualitative analyses to achieve theoretical saturation.⁵⁰

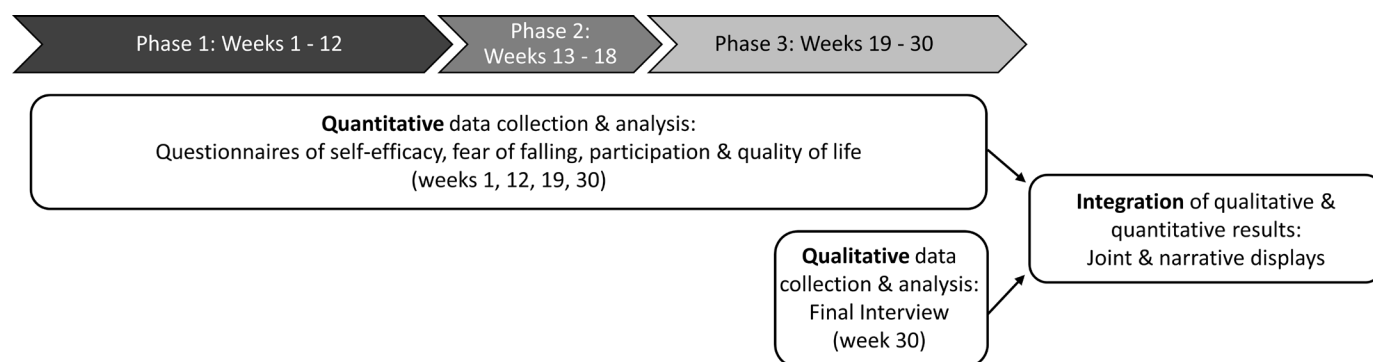


Figure 1 Mixed methods process with timeline. Phases 1 and 3 will involve tracking participant falls. Phase 2 will involve the photovoice intervention.

Table 1 Schedule of enrolment, interventions and assessments

Timepoint	Study period				
	Enrolment		Post enrolment		
	-t0	t1 (start Phase 1)	t2 (end Phase 1/ start Phase 2)	t3 (end Phase 2/ start Phase 3)	t4 (end Phase 3)
Enrolment:					
Screen	X				
Consent	X				
Interventions:					
Photovoice			-----		
Assessments:					
ABC Scale*		X	X	X	X
WheelCon†		X	X	X	X
FES-I*		X	X	X	X
SCI-FCS†		X	X	X	X
SAFE		X	X	X	X
IPA		X	X	X	X
LiSAT-9		X	X	X	X
Track falls		-----		-----	
Final Interview					X

Dotted horizontal lines indicate the period during which the intervention (ie, photovoice) was delivered or falls were tracked.

*To be completed by participants who ambulate.

†to be completed by participants who use a wheelchair.

ABC Scale, Activities-specific Balance Confidence Scale; FES-I, Falls Efficacy Scale—International; IPA, Impact on Participation and Autonomy Questionnaire; LiSAT-9, Life Satisfaction Questionnaire 9; SAFE, Survey of Activities and Fear of Falling in the Elderly; SCI-FCS, Spinal Cord Injury Falls Concern Scale; WheelCon, Wheelchair Use Confidence Scale v.3.

To recruit participants, study notices will be circulated through the newsletters and social media of the North American SCI Consortium and the provincial branches of Spinal Cord Injury Canada. Study notices will also be distributed through the Central Recruitment database of the Toronto Rehabilitation Institute.⁵¹ This database contains names of prior inpatients with SCI who are interested in participating in research. These strategies will facilitate the widespread recruitment of individuals living with SCI from across Canada and the United States.

Questionnaires

Each participant will complete questionnaires at four time points: the beginning of each phase and the end of phase 3. A significant change in the measured constructs during phase 1 may suggest an alteration of behaviour and/or perceptions as a result of being observed (ie, Hawthorne effect).⁵² Clinically relevant changes in the measured constructs during phases 2 and 3 will provide insight into the immediate and longer term effects, if any, of photovoice. To measure falls self-efficacy, participants with SCI who ambulate will complete the ABC Scale,⁵³ while those who use a wheelchair will complete the Wheelchair Use Confidence Scale (WheelCon).^{54–56} The Falls Efficacy Scale—International (FES-I)⁵⁷ and Falls Concern Scale for SCI¹⁶ will measure concern or fear of falling in participants who ambulate or use a wheelchair,

respectively. Separate, modified versions of the Survey of Activities and Fear of Falling in the Elderly (SAFE)⁵⁸ for ambulators, manual wheelchair users and power wheelchair users will also be used to measure fear of falling. All participants will complete the Impact on Participation and Autonomy Questionnaire (IPA)⁵⁹ and the Life Satisfaction Questionnaire 9 (LiSAT-9).⁶⁰

Primary outcomes

The *ABC Scale* is a valid and reliable measure of balance confidence in ambulatory persons with SCI.¹⁹ It is comprised of 16 standing or walking tasks (eg, stand on a chair to reach, walk on an icy sidewalk) that are prefaced by the following statement: “How confident are you that you will not lose your balance or become unsteady when you...”.⁵³ The response scale ranges from 0% (no confidence) to 100% (completely confident) and the total score is calculated as a mean score of all 16 items. The minimal detectable change (MDC) of the ABC Scale is 14.9% in the ambulatory SCI population.¹⁹

The *WheelCon v.3* is a questionnaire designed for participants who are non-ambulatory, with separate versions for power (WheelCon-P) and manual (WheelCon-M) wheelchair users.^{55 56} It encompasses six different wheelchair-related topics, with the first two reflecting falls self-efficacy: negotiating the physical environment and performing activities in the wheelchair. The WheelCon-P is comprised

Box 1 Agendas of group meetings

Group meeting 1 (week 1 of phase 2)

1. Introductions and project overview
2. Introduction to falls after spinal cord injury (SCI)
 - Review definitions of fall, wheelchair tip, near fall, fear of falling
 - Incidence of falls after SCI
 - When, where and why falls occur after SCI
3. Discussion questions
 - Did anything in this presentation surprise you?
 - What do you feel may be helpful to take from this presentation?
 - What would you like to focus on in the future regarding falls?
4. Photography basics
 - Privacy and ethical aspects of photography
 - Basics of photo taking
 - Adaptations for those with reduced hand function

Group meeting 2 (week 2 of phase 2)

1. Fall prevention and management after SCI
 - Discussion of SCI-specific fall prevention tips and management gained from previous literature^{31,32,69,70}
 - Share experiences with fall prevention and management
2. Introduction to photovoice
 - Overview of photovoice process
3. Photo assignment #1
 - Explanation of assignment and how to share photos with research team
 - Assignment question: What decreases your likelihood of falling?
 - Photovoice examples from peer mentors and photographer
4. Photography tips
 - Compositional rules in photography
 - Open question and answer

Group meeting 3 (week 4 of phase 2)

1. Sharing of photos from photo assignment #1
 - Participants share 1–2 photos
 - Sharing of strategies used to reduce fall risk
2. Photo assignment #2
 - Explanation of assignment and how to share photos with research team
 - Assignment question: How do you reduce the risk of falling so that you can participate in meaningful activities?
 - Photovoice examples from peer mentors and photographer
3. Photography tips
 - Capturing motion in photos
 - Open question and answer

Group meeting 4 (week 6 of phase 2)

1. Sharing of photos from photo assignment #2
 - Participants share 1–2 photos
 - Sharing of strategies used to reduce fall risk
2. Brainstorm how to share knowledge gained through photovoice
 - Who should the information be shared with?
 - How should the information be shared?
3. Photography tips
 - Photo displays
 - Open question and answer

of 59-items, and the WheelCon-M is comprised of 65-items, prefaced by the following statement: “As of now, how confident are you that you:”. Sample items common to both measures include opening and going through

a lightweight door and transferring from wheelchair to bed. The response scale ranges from 0% (no confidence) to 100% (completely confident) and the total score is calculated as a mean score of all items. The WheelCon was shown to have excellent test–retest reliability, validity and responsiveness in a group of wheelchair users, 60% of whom had SCI.⁴⁸ The smallest real difference of the WheelCon-M is 16.4%.⁴⁸

The *FES-I* is a questionnaire that measures concern about falling during 16 physical and social activities, such as ‘taking a bath or shower’, ‘going up or down stairs’, and ‘going to the shop’.⁵⁷ It has been validated in ambulatory persons with SCI.⁶¹ Participants rate their concern about falling during each activity on a four-point scale (ranging from 1=not at all concerned to 4=very concerned). Items are summed to yield a total score which can be compared against established cut-points in older adults that differentiate between low, moderate and high concern about falling.⁶²

The *Spinal Cord Injury Falls Concern Scale* is a valid and reliable questionnaire that measures concern about falling during daily activities for wheelchair users with SCI.¹⁶ It was designed for manual wheelchair users, but has been used for people with SCI who are power wheelchair and scooter users.⁶³ It is comprised of 16 physical activities (eg, transferring in and out of bed, pushing the wheelchair up or down a slope), each of which is rated on a four-point Likert scale of concern about falling (ranging from 1=not at all concerned to 4=very concerned). The total score is calculated by summing the scores of all items.

Secondary outcomes

The *SAFE* is a measure of the impact of fear of falling on restriction of activity that was developed for use with older adults.⁵⁸ Modified versions of the *SAFE* for ambulators, manual wheelchair users and power wheelchair users will be used. Previous research has used modifications of the *SAFE* to suit different cultural and research contexts (eg, linguistic differences and face-to-face interview vs self-administered, respectively).⁶⁴ The *SAFE* has demonstrated reliability and validity in older adults⁶⁵; however, the measure’s psychometric properties have not been evaluated in the SCI population, which consists of younger individuals. The *SAFE* poses 11 different activities (eg, ‘Go out to the store’, ‘Get out of bed’, etc) and for each it addresses both behavioural and cognitive aspects of fear of falling. Participants are asked if they currently do the activity (yes/no), and how worried they are about falling or would be while doing the activity (ranging from 0=not at all worried to 3=very worried). If the answer is no, they are asked whether they avoid the activity because of worry about falling (yes/no).

The *IPA* represents the participation domain of the ICF. It has demonstrated reliability and validity in SCI.^{66,67} The *IPA* contains 39 items across five subscales: autonomy indoors, autonomy outdoors, family roles, social relations and paid work and education.⁵⁹ The response scale to each item is scored as follows: 0=very good, 1=good,

Table 2 Semistructured interview guide for photovoice intervention**Part 1: Questions asked at individual interviews #1 and #2**

For each photo that the participant would like to discuss, follow the questions in the SHOWeD framework⁷⁰:

1. Do you have a caption for this photo? What do you see here?
2. What is really happening here? (INTERVIEWER PROBE: What does the picture represent to you? What is happening that caused you to take this photo?)
3. How does this relate to our lives? (INTERVIEWER PROBE: How does this issue or factor impact your life?)
4. Why does this situation, concern or strength exist?
5. What can we do about it? (INTERVIEWER PROBE: How do you think the situation could be improved?)

Part 2: Questions asked at only one individual interview

Individual interview #1	Individual interview #2
<ol style="list-style-type: none"> 1. What decreases your likelihood of falling? (Discussion can expand beyond the photos taken.) 2. For each factor or situation mentioned ask: <ul style="list-style-type: none"> – How did you discover that (stated factor/situation) decreases your likelihood of falling? – Why do you think the (stated factor/situation) decreases your likelihood of falling? – Could the (stated factor/situation) be applied to other situations/activities to reduce fall risk? 	<ol style="list-style-type: none"> 1. How do you reduce the risk of falling so that you can participate in meaningful activities? (Discussion can expand beyond the photos taken.) 2. For each strategy mentioned ask: <ul style="list-style-type: none"> – How did you discover that (stated strategy) enabled you to participate in (stated meaningful activity)? – Why do you think the (stated strategy) enables your participation? – Could the (stated strategy) be applied to other activities to increase participation?

2=fair, 3=poor, 4=verypoor. Scores on items from the same subscale are summed to create subscale scores. Higher scores indicate lower participation/autonomy. Values for the MDC for each domain were established by Noonan and colleagues.⁶⁶

The *LiSAT-9* is a self-report measure assessing quality of life^{68 69} that is valid and responsive among the SCI population.^{60 69} It consists of nine items that query the overall quality of life, as well as satisfaction with eight different domains, such as occupation, management of self-care, leisure activities and relationships. Each item is prefaced with the question: ‘How satisfactory are these different aspects of your life?’ and a six-point response scale is used (ranging from 1=very dissatisfying to 6=very satisfying). The nine items are averaged to obtain a total score.

Tracking falls

Falls will be monitored for 12 weeks preceding the photovoice intervention (ie, phase 1) to describe participants’ recent fall history. Falls will also be tracked for 12 weeks following the photovoice intervention (ie, phase 3) and discussed in the final interview. Participants will be provided with a falls calendar in both electronic (LimeSurvey Version 3) and paper formats. They will also be offered the option to complete the falls calendar over the phone with a researcher. For reference, the following definition for a fall will be provided: ‘an event where one comes to rest inadvertently on a lower level’.² Participants will be asked to record each fall within 24 hours of experiencing the fall, as well as to note any injuries sustained and any medical attention required as a result of the fall. A researcher will phone or email participants every 2 weeks during phases 1 and 3 to ensure falls are being documented.

Photovoice intervention

The 6-week photovoice intervention (ie, phase 2) will consist of four group meetings, two photo assignments and two individual interviews. Participants will complete the intervention in groups of about 10 participants.⁷⁰ Participants will be grouped according to mobility status (ie, ambulates or uses a wheelchair). Group meetings will be led by two researchers (KEM, JDS), with 2–3 peer mentors present to facilitate discussion. Group meetings are expected to last approximately 1.5 hours and will not be audio recorded. The peer mentors will be individuals with SCI who are community dwelling and have participated in our prior photovoice research. Peer mentors will attend group meetings and individual interviews according to their mobility status. The similarities between participants and peer mentors are in keeping with recommendations regarding peer mentor background and qualifications.⁷¹ Also present at each group meeting will be a photographer with SCI who will provide photography tips. An outline of the content that will be discussed at each group meeting is summarised in [box 1](#).

Two photo assignments will be introduced during the group meetings ([box 1](#)). For each assignment, participants will be given verbal and written instructions asking them to take 4–6 pictures to answer a question (ie, ‘What decreases your likelihood of falling?’ and ‘How do you reduce the risk of falling so that you can participate in meaningful activities?’ for photo assignments 1 and 2, respectively). Photo assignment 1 poses a broader question about fall prevention, whereas photo assignment 2 asks participants to reflect on fall prevention strategies that have enabled them to maintain or resume participation in activities that are important to them. Example

photos will be shared with participants; the peer mentors and photographer will share photos that they took for the two photo assignment questions. The photo assignment will be completed over 7 days; a time period used in prior studies.^{7 9 26 28 29 34} It is possible that allowing more time for photo taking may facilitate more reflection on falls, fall risk and fall prevention by participants; however, a period of 7 days was selected to balance the need for reflection and the need for a feasible intervention length (ie, 6 weeks). If a participant has difficulty manipulating a camera or phone, adaptations will be recommended or a caregiver or friend may assist.

Two individual, semi-structured interviews will take place over the course of the photovoice intervention (ie, weeks 3 and 5 of phase 2). These interviews will last approximately 1 hour and be facilitated by a researcher (JDS) and one peer mentor whose mobility status matches that of the participant. The semi-structured interview guide will follow the SHOWeD framework of photovoice, in which participants will be asked what is happening in each photo, why the depicted situation exists, and what can be done about the situation (table 2).⁷⁰ The SHOWeD framework facilitates discussion about the photos at a deeper level.⁷² Additional open-ended questions may be added to the interview guide as the study proceeds to explore topics discussed in previous interviews.⁷³ The individual interviews will not be audio recorded.

Final interview

On completion of phase 3, an individual, semi-structured interview will be conducted to explore participants' perceptions of the photovoice intervention following a qualitative descriptive design. The timing of this interview will enable participants to reflect on the impact of the intervention on their falls self-efficacy, participation in meaningful activities, quality of life and occurrence of falls. A semi-structured interview guide consisting of open-ended questions will be followed (box 2). This final interview will be completed by a research team member with expertise in qualitative methodology who is not involved in the delivery of the photovoice intervention. The interviews are expected to take approximately 1 hour and will be recorded and transcribed verbatim by a researcher.

Data analysis

Quantitative data will be analysed using R (The R Foundation) or SPSS (IBM Corp.) statistical software. The assumption of normality will be tested with the Shapiro-Wilks test for all continuous variables. When normality is violated, non-parametric tests will be used. Alpha will be set at 0.05.

Analyses will be performed separately for the ambulatory and wheelchair groups. The questionnaires will be scored according to each questionnaire's instructions. As appropriate, descriptive statistics will be presented as mean and SD, frequency counts, or median and IQR. To address the primary objective and secondary objective 1, scores on the questionnaires will be compared over time

Box 2 Semi-structured interview guide for final interview

In this interview, we will explore your experiences with, and opinion of, photovoice as a fall prevention intervention.

1. To begin, please describe your experience with the photovoice intervention?
 - a. PROBES: What worked well with the photovoice intervention?
 - b. What things did you enjoy about the photovoice intervention?
 - c. How satisfied are you with the photovoice intervention?
 - d. What did not work well with the photovoice intervention?
 - e. What things did you not enjoy about the photovoice intervention?
2. I would like your opinion about the logistics of the intervention:
 - a. Overall, how did you find the training?
 - b. PROBES: How could the training be improved?
 - c. Was there anything you were still confused about after the training (eg, what to take pictures of, how to take pictures, etc)?
 - d. What are your thoughts about the length of the training?
3. Now, I would like to understand the effects of the photovoice intervention. Could you please describe what effects you think the photovoice intervention had?
 - a. Did the photovoice intervention impact how confident you are at avoiding falls in your day-to-day activities? If yes, how so? If no, why do you think the intervention had no effect on how confident you are at avoiding falls in your day-to-day activities?
 - b. Did the photovoice intervention impact how confident you are with your balance? If yes, how so? If no, why do you think the intervention had no effect on how confident you are with your balance?
 - c. Did the photovoice intervention impact your participation in meaningful activities in your home and in the community? If yes, how so? If no, why do you think the intervention had no effect on your participation in meaningful activities?
 - d. Did the photovoice intervention impact how satisfied you are with your life? If yes, how so? If no, why do you think the intervention had no effect on how satisfied you are with your life?
4. Please describe any other benefits or challenges you had during the photovoice intervention. PROBE: Were there specific benefits or challenges related to this being completed entirely virtually?
5. Let's talk about how the intervention could be improved. Please describe any recommendations for how you think the photovoice intervention could be improved?
 - a. PROBES: What would make the intervention easier for you to use?
 - b. What was missing from the intervention?
 - c. Would you have preferred if this had been in-person or a mix of in-person and virtual?
 - d. What would improve the virtual delivery of the study?
6. Would you be interested in being involved in future knowledge sharing events to increase awareness about falls and fall prevention after spinal cord injury?
 - a. If yes, how would you like to be involved?
 - b. What would be the best way to share knowledge?
 - c. Who would be the target audience for this knowledge sharing? Other participants, inpatients, community members, clinicians?
7. To end, could you please summarise your overall opinion of the photovoice intervention for fall prevention in a few sentences?
8. Is there anything you want to mention that we haven't already discussed?

with a repeated measures ANOVA or Friedman's test (when the assumption of normality was not met) to check for within-group changes. The generalised estimating equation will be used to estimate regression parameters

for the mean scores on the questionnaires given a set of independent variables, such as age and sex.

To pursue secondary objective 2, a reflexive thematic analysis⁷⁴ will be conducted on the final interview transcripts. Analyses will be performed separately for the ambulatory and wheelchair groups. Three researchers experienced with qualitative analyses will independently read the transcripts and derive key themes from them. These researchers will then compare and discuss their findings to seek consensus on themes and meaning of the data. NVivo V.12 (QSR International) will be used for data management. Participants' responses to question 3 in the interview guide (box 2) will be merged (ie, integrated) with the quantitative results (figure 1).⁷⁵ This mixed methods approach will provide the opportunity to identify complementary, convergence, and/or divergence of findings. To do this, the quantitative and qualitative datasets will be compared. Common concepts across the two datasets will be identified, and the quantitative and qualitative findings for each concept compared. Side-by-side comparisons will be facilitated by the use of joint displays and narrative displays.^{75 76} The ways in which the qualitative and quantitative results confirm, disconfirm or expand one other will be identified.⁷⁷ Participants' responses to the remaining questions in the interview guide will be used to explore the participants' experiences with, and perceptions of, the photovoice intervention (ie, secondary objective 2). In addition, a secondary qualitative comparative analysis will be conducted to examine differences within and between the groups⁷⁸ in attitudes or values concerning photovoice as a fall prevention intervention. Multiple methods will be used to enhance the trustworthiness of the qualitative data^{79 80}:

- ▶ Credibility will be enhanced through prolonged participant engagement.
- ▶ Multiple data collection sources will be used (ie, photographs, verbal interviews) to confirm the qualitative interpretations are supported by data (ie, methodological triangulation).
- ▶ Qualitative analysis will involve multiple researchers (ie, researcher triangulation).
- ▶ Transferability will be enhanced by providing thick descriptions of the participants and setting.
- ▶ An audit trail documenting analytic decision made throughout the research will enhance the dependability and accountability.
- ▶ Characteristics of the researchers involved in data collection and analysis will be reported to enhance transparency.

Patient and public involvement statement

The study protocol was developed with frequent input from individuals living with SCI. Photovoice is a participatory action research method that engages individuals with lived experience in data collection, analysis and dissemination. Participants of our prior photovoice studies contributed to the development of the photovoice intervention for falls self-efficacy described here.^{28 29} As

detailed above, previous participants identified components they would like to see in fall prevention initiatives for individuals living with SCI. The peer mentors and photographer also provided input into the delivery and content of the intervention.

Ethics and dissemination

The trial is registered with ClinicalTrials.gov (NCT04864262). The Research Ethics Board of University Health Network approved the study herein (ID #20-6312). Prospective participants are informed verbally, as well as in writing in the consent form, of the potential risk to confidentiality by participating in the group meetings. Written informed consent will be obtained by the study coordinator (KC). The consent process will follow institutional REB requirements and will proceed as follows:

- ▶ Potential participants are sent the consent form via email or mail, depending on their preference.
- ▶ If interested in participating in the study, the potential participant reaches out to the study coordinator to set up an online or phone meeting at which the study procedures, risks and potential benefits are reviewed, and participant's questions are answered.
- ▶ If the potential participant decides to consent, the signed consent form is returned to the study coordinator by email, mail or University Health Network File Share.

The privacy and ethical aspects of photography will be discussed at the first group meeting and reviewed at subsequent group meetings. For example, if participants wish to take a photo of another person as part of the photo assignment, they will be instructed to have the individual complete a photo release form. Participants will also be instructed to avoid taking pictures of people under the age of 18 years.

Our knowledge translation goals consist of the dissemination and implementation of the study findings by knowledge users. The primary knowledge users will be people living with SCI. Dissemination activities targeting this group will be developed with input from the study participants. For example, participants' photos and quotes may be converted into printed and online art displays, which may be shared through the websites and newsletters of community SCI organisations. Additional knowledge users will include healthcare administrators and rehabilitation clinicians as these individuals make decisions about fall prevention practices in SCI rehabilitation. Hence, dissemination initiatives will also target professional associations representing these groups. To reach researchers in the SCI rehabilitation field, we will present our findings at academic conferences and in rehabilitation-focused journals.

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Contributors KEM conceptualised the study, with input on the study design from HS, SM, MA, KC and JDS. JDS and KEM wrote the manuscript. KC, HS, SM, AK and MA reviewed and provided edits to the manuscript.

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Patient and public involvement Patients and/or the public were involved in the design, or conduct, or reporting, or dissemination plans of this research. Refer to the Methods section for further details.

Patient consent for publication Not applicable.

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