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Exploring the experiences of an exercise-based telerehabilitation program among Canadian community-dwelling adults with stroke

Elise Wiley¹, Brodie Sakakibara², Sarah Park³, Ruth Barclay⁴, Mark Bayley^{5,6}, Janice J. Eng⁸, Anne Harris⁹, Elizabeth Inness^{6,7}, Marilyn MacKay-Lyons,¹⁰ Joy MacDermid^{1,11}, Courtney Pollock⁸, Sepideh Pooyania¹², Robert Teasell¹³, Jennifer Yao¹⁴, Ada Tang¹

¹School of Rehabilitation Science, McMaster University, Hamilton, ON, L8S 1C7, Canada

²Department of Occupational Science & Occupational Therapy, Centre for Chronic Disease Prevention and Management, Southern Medical Program, University of British Columbia, Kelowna, BC, V1V 1V7, Canada

³School of Rehabilitation Sciences, University of British Columbia, Vancouver, British Columbia, BC, V6T 1Z3, Canada

⁴Department of Physical Therapy, Faculty of Health Sciences, University of Manitoba, Winnipeg, MB, R3E 0T6, Canada

⁵Department of Medicine, Division of Physical Medicine and Rehabilitation, University of Toronto, Toronto, ON, M5G 1V7

⁶Toronto Rehabilitation Institute, University Health Network, Toronto, ON, M5G 2C4

⁷Department of Physical Therapy, University of Toronto, Toronto, ON, M5G 1V7, Canada

⁸Department of Physical Therapy, University of British Columbia and Centre for Aging SMART at Vancouver Coastal Health, Vancouver, BC, V6T 1Z3, Canada

⁹G.F Strong Rehabilitation Centre, Vancouver, BC, V5Z 2G9, Canada

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¹⁰School of Physiotherapy, Faculty of Health, Dalhousie University, Halifax, NS, B3H 4R2,
Canada

¹¹School of Physical Therapy, Western University, London, ON, N6A 1H1, Canada

¹²Department of Internal Medicine, Faculty of Medicine, University of Manitoba, Winnipeg,
MB, R3A 1R9, Canada

¹³Department of Physical Medicine and Rehabilitation, Schulich School of Medicine and
Dentistry, University of Western Ontario, London, ON, N6A 5C1

¹⁴Department and Faculty of Medicine, Division of Physical Medicine and Rehabilitation,
University of British Columbia, Vancouver, V5Z 2G9

Author of correspondence:

Ada Tang, PT PhD

McMaster University, 1400 Main St West, Institute for Applied Health Sciences, Room 437
Hamilton, Ontario, Canada L8S 1C7

e: atang@mcmaster.ca, p: (289) 426-5762

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1 **Abstract (197/200)**

2 **Introduction:** Telerehabilitation is emerging as a means for delivering stroke rehabilitation to
3 address unmet lower extremity rehabilitation needs. However, there is currently limited and low-
4 quality evidence supporting the use telerehabilitation interventions for lower extremity recovery
5 after stroke. Thus, we developed an exercise-based telerehabilitation program (TRAIL) for safe
6 and effective promotion of lower extremity function after stroke. This study reports on the
7 qualitative findings from the feasibility study of the TRAIL program.

8 **Methods:** An interpretive description methodology and inductive thematic analysis approach
9 were undertaken. One-on-one semi-structured interviews were conducted on a subset of
10 participants who completed the TRAIL feasibility study. Participants were recruited via email
11 and enrolled into the study based on pre-determined purposeful sampling strategies.

12 **Results:** Ten participants (6 men, 4 women) completed a semi-structured interview. Two main
13 themes emerged: (i) TRAIL ingredients for success and (ii) telerehabilitation is a viable option
14 for stroke rehabilitation.

15 **Conclusion:** Exercise-based telerehabilitation appears to be well-received by men and women
16 post-stroke when social support, professional guidance, and program resources are offered.
17 TRAIL may also prolong the continuum of care that individuals receive once they are discharged
18 back into the community, and contribute to improvements in mobility, lower extremity strength
19 and balance.

20

Background

With over 80 million individuals living with stroke worldwide [1], acute and long-term support systems are paramount to promote stroke recovery [2]. Unfortunately, however, mobility impairments [3], balance and falls concerns [4,5], and lower extremity strength deficits [6,7] are among the unmet rehabilitation needs commonly reported by individuals post-stroke. If left unaddressed within 1-year of stroke, such unmet needs are likely to reduce quality of life [8], reduce the ability to perform activities of daily living (ADLs) and increase the risk for institutionalization [9]. Thus, physical therapy-based rehabilitation is paramount for the recovery of lower extremity limitations.

Telerehabilitation is emerging as a means for delivering stroke rehabilitation services to address unmet lower extremity rehabilitation needs, due to key factors such as its accessible, economical, and time-efficient nature for both patients and therapists [10]. A recent Cochrane review of three trials involving 106 participants post-stroke reported equivalent improvements in mobility and balance outcomes between in-person and telerehabilitation interventions [11]. These findings are limited, however, by the small number of trials and low quality of evidence for lower extremity recovery with telerehabilitation interventions [11]. Of these studies, only one study (n=16 participants) facilitated synchronous, face-to-face, interactions between the therapist and participants via a videoconferencing platform [12].

Thus, we developed a new exercise-based telerehabilitation program, TeleRehabilitation with Aims to Improve Lower extremity function post-stroke [TRAIL] designed to safely and effectively promote lower extremity recovery after stroke. The TRAIL program is a 4-week, therapist-led progressive intensity exercise and self-management program, delivered using videoconferencing platforms in a $\leq 2:1$ participant-to-physiotherapist (PT) ratio. Participants

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received two 60-90-minute synchronous telerehabilitation sessions per week (total 8-12 hours of telerehabilitation). In addition to the real-time guidance provided by a trained PT, participants received an *Exercise Manual* that offered visual illustrations and written instructions for modifying the level of difficulty of the lower extremity-focused exercises.

The TRAIL program was also designed to include a self-managed exercise component, of which was modeled after systematic review evidence that positive self-management behaviours promote sustainable long term exercise behaviours [13]. This portion of the program was facilitated by a *Participant Exercise Log* consisting of action plans of TRAIL exercises. The action plans were developed collaboratively between each participant and their PT, with participants being instructed to independently execute the action plan of TRAIL exercises at least once per week, in addition to their formal bi-weekly sessions. At the beginning of each week, the participant and PT debriefed on whether the successful undertaking of their action plan was achieved. If not feasible, evaluation and further refinement of the action plan was enforced.

We recently completed a single group pre-post feasibility study of TRAIL with 32 participants post stroke, with findings indicating high treatment fidelity, program satisfaction, and program adherence with no dropouts or serious adverse events [14]. We also noted positive trends in mobility (Timed Up and Go) and motor impairment (Fugl-Meyer Lower Extremity Assessment) [14]. These quantitative findings are encouraging, but seeking the perspectives of stakeholders and end-users involved with telerehabilitation programs is also of value to understand the acceptability of stroke telerehabilitation, and exploring opportunities for further refinement in TRAIL program delivery.

Indeed, previous qualitative studies have explored the acceptability of telerehabilitation in individuals with stroke and found that participation is facilitated by perceived improvements

in physical and psychological impairments [15–18], enjoyment [15,16,19], ability to track progress [16], accessibility [15,17–20], affordability [17], and external support from the therapist and family members [15]. Documented barriers to participation in exercise-based telerehabilitation include challenges with technological setup and interface [15–18], lack of physical touch from the therapist [17,20], repetition in the types of exercises [17], and inadequate spacing in the physical environment [15]. We note however that the themes arising from these previous studies involved virtual reality [16], robotic or exergame style (i.e., sensor-based) [15,17] or multi-component (e.g., goal-setting, information sharing and exercise) [20] with limited emphasis on real-time therapist instructed and guided programs for lower extremity recovery after stroke [21]. We note that asynchronous virtual reality-based platforms may be limited to the delivery of auditory prompts (e.g., automated claps and cheers) as the primary method of performance feedback [16], thereby further limiting opportunities for face-to-face interactions with therapists. Thus, there remains a need to understand the experiences with synchronously delivered telerehabilitation programs among individuals with stroke.

This study reports on the qualitative findings from the feasibility study of the TRAIL program. The primary objective of this study was to develop a deeper understanding of the complex interactions of experiences in relation to telerehabilitation post-stroke. Specifically, our emphasis was to describe and understand the experiences [22] of the individuals post-stroke who participated in TRAIL in terms of their perceptions of the program delivery and resources, as well as lower-extremity related rehabilitation outcomes.

Methodology

Study Design

We used an interpretative description (ID) qualitative study design to address our study aims [23,24]. The study was approved by the University of British Columbia Clinical Research Ethics Board (ID# H21-00133) and McMaster University Hamilton Integrated Research Ethics Board (ID #13361), and was completed with a subset of participants involved with the multi-centred TRAIL feasibility study (NCT04265664). All study procedures were followed in accordance to the COsolidated criteria for REporting Qualitative research (COREQ) checklist [25] and guidelines outlined by the respective institutional research ethic committees. Informed written consent was obtained from all participants.

Participants

For the TRAIL feasibility study, we included individuals with mild to moderate lower extremity impairment from stroke. Individuals were eligible if they were 19 years of age or older, within 18 months of stroke with lower extremity hemiparesis, able to walk 10 metres without physical assistance of another person, able to tolerate 50 minutes of activity with rest breaks, had a helper available to provide physical support during the assessment sessions, had cognitive-communicative ability to participate, and were able to provide informed consent. Potential participants were excluded if they were receiving in- or outpatient rehabilitation focused on lower extremity recovery, living in long-term care, had severe vision or hearing loss or other neurological conditions, presented with significant comorbidities, were not medically stable, or if they had planned surgery that would preclude or affect safe participation in TRAIL.

To maximize participant safety in the TRAIL study, precautionary measures were implemented. Firstly, the delivery of all study procedures were by a physical therapist registered to practice in the same jurisdiction as the participant, who also received 5-hours of comprehensive training and detailed written manuals. Furthermore, pre- and post-participation

1 checklists that included emergency contact information and considerations for current health
2 status and room/technological setup were completed for each participant. Finally, all exercises
3 could be modified (graded from less to more challenging) to suit participants' abilities and/or to
4 minimize risk of harm.

5 Additionally, as older adults tend to possess lower levels of knowledge and confidence
6 with technology [26], the onboarding process for the TRAIL program involved two orientation
7 sessions (i.e., familiarizing the participant with the videoconferencing platform, establishing
8 camera angles and adequate placement of the device). Participants also received a *Participant*
9 *Manual* which reinforced the space requirements (e.g. dimensions, lighting, free from trip
10 hazards), technology requirements (e.g. device specifications), and safety requirements (e.g. pre-
11 participation checklist, availability of hand support during standing exercises).

12 Participants were recruited from 5 sites (Halifax, Winnipeg, Vancouver, London,
13 Toronto) from the CanStroke Recovery Trials Platform which is a network of Canadian sites to
14 facilitate participant recruitment and quality trial practices [27]. Based on institutional licenses
15 held at each site, the videoconferencing program used to administer the telerehabilitation
16 program was either Microsoft Teams[®] or Zoom[®].

17 To be included in this qualitative study of TRAIL, participants needed to have completed
18 the TRAIL program and consented to be contacted for future studies.

19 ***Recruitment and Sampling Strategies***

20 Participants were recruited via email by the study coordinator of the feasibility study (SP).
21 Prior to applying our specific sampling strategies, all 32 participants were eligible to participate
22 as they had all completed the TRAIL program. Purposeful sampling strategies including
23 criterion-i (i.e., meeting program inclusion described above) and maximum variation [28] were

employed. We performed maximum variation sampling based on geographic location and on gender identity, to understand whether these factors influenced how participants experienced TRAIL. Individuals residing in rural areas tend to have lower incomes, access to technology can be limited [29], and substantial travel time requirements and costs pose as barriers to accessing stroke care [30]. Previous studies have also shown that women possess lower exercise self-efficacy and motivation for exercise than men [31–33], which may be a product of receiving less external social support [34,35]. Older men also are known to have higher levels of proficiency and enjoyment in internet and technology use [36] and experience fewer barriers to participation in stroke rehabilitation than women [37]. To fulfill our maximum variation sampling strategy on gender identity and geographical location, we aimed to interview one man and woman from each of the five sites. Eight out of the 32 participants who completed the feasibility study identified as women, whereby one site did not enroll any women over the course of the feasibility study due to challenges with recruitment of women with stroke. Thus, a total of 4 women and 6 men were enrolled into the qualitative study. One potential participant declined to participate in the study, and another did not respond to the research team's communications.

Interviews were guided by the principle of evolving conceptualizations arising from the ongoing data analysis, allowing for elaboration on the emerging themes and interpretations not only within, but also between participant accounts [38]. We note that there were no other sampling strategies employed throughout the iterative data collection and analysis processes, as there were no deviant or extreme cases observed and the aforementioned sampling strategies allowed for a rich understanding of the research question.

Data Collection

Informed written electronic consent was obtained using a University of British Columbia licensed Qualtrics form. The survey link was sent to the participant a week in advance for their review, and completed in real-time with the study coordinator over Zoom prior to the interview. At this time, any questions or concerns expressed by the participant were addressed. After participants provided informed consent, a date and time was scheduled for a one-on-one semi-structured interview, held and recorded over Zoom[®] videoconferencing software. Each participant completed one interview. With the participant's consent, the audio and video features of Zoom[®] were used to conduct the study. Interviews approximated 45 minutes in length, and were facilitated by EW and guided by a pre-established interview guide (created in May 2021) with questions related to the overarching concepts of: (i) stroke rehabilitation and recovery (e.g., *What was the recovery journey like for you? What resources or supports, if any, were available to you? What did you use?*) (ii) TRAIL program experience (e.g., *How easy/difficult was it for you to participate in the TRAIL program?; How did you find the exercises?*), (iii) delivery of the program (e.g., *How would you describe your experience with your therapist using video conferencing technology*), and (iv) program resources (e.g., *How did you use the manuals that were provided to you?*). The interviewer (EW) also paid close attention the participants' facial expressions and emotional reactions or responses, and made note of relevant observations that were added as memos during the coding process. The interview guide also included a set of potential follow-up questions, to account for vague or ambiguous responses. The interviewer also asked specific and relevant follow-up questions in scenarios where a more in-depth discussion was warranted.

Data Analysis

Interview transcripts were transcribed verbatim by a trained transcriptionist. Identifiable data were removed and replaced with a participant identification number during transcription. Data analysis involved inductive thematic approach with themes being derived from the data [38,39].

Repeated readings of each transcript were conducted by the primary author (EW) prior to embarking on the coding process [23]. This process was critical to facilitate the emergence of novel perspectives and insights throughout each reading. Data were analyzed using a hand coding approach on Microsoft Word and Excel. As we followed an ID methodology, codes were identified in the data using a broad-based coding approach (i.e., avoiding excessive line-by-line coding) [39] and a codebook with relevant codes and definitions was created after analyzing the initial two transcripts. As the analysis process evolved, the codebook was refined where new codes were added and defined. Next, categories (i.e., sub-themes) were identified [23,40] by grouping coding segments with similar properties and provided with a label [23]. To facilitate this process in Excel, a color-coded legend with each category was provided. Finally, key categories were consolidated into overarching key themes and generated a thematic map of the analysis [23].

Trustworthiness and Rigour

The primary research team engaged in many steps to uphold trustworthiness and rigour in this qualitative study [41]. Each member of the research team noted their reflective biases. The first author, EW (she/her), is a graduate student in Rehabilitation Science and interested in sex and gender considerations in stroke telerehabilitation research. SP (she/her) is a former graduate student in Rehabilitation Science with an interest in stroke telerehabilitation and was the study coordinator for the TRAIL feasibility study. The co-primary investigators of the TRAIL studies

(BMS PhD, he/him and AT PT PhD, she/her) shared research expertise on telehealth, exercise, and self-management after stroke was leveraged in the conception of the interview guide and data analysis. Data analysis was also informed by the collective perspectives of team members with research expertise in virtual stroke rehabilitation research. All other co-authors (MB, RB, JJE, AH, EI, ML, JCM, SeP, CP, RT, and JY) were instrumental in reviewing the different iterations of the manuscript.

To further enhance trustworthiness and rigour, data source triangulation was implemented. Prior to the interviews, EW observed 2 participants during TRAIL sessions, taking field notes on participant engagement in TRAIL and interaction with their therapist. As well, EW conducted all interviews, with SP observing the initial two interviews and debriefing with EW on the field notes from those interviews.

Stepwise replication of coding involved EW and SP independently coding the first 2 transcripts and discussing the derived codes to ensure consistency and dependability of the initial codebook [23,42]. EW then independently coded the remaining transcripts using the initial codes, as well as continued to add new codes . Near the final stages of data analysis, frequent meetings were held between EW, SP, BSM, and AT to discuss and refine the identified themes. If present, the team also planned to discuss any deviating themes or concepts. Finally, an audit trail was created to capture the decisions involved with the analysis process that led to the final interpretation of the data [38].

Results

Participant demographics (6 men; 4 women) are provided in Table 1 [insert Table 1 here]. Two main themes were identified in the data: 1) TRAIL ingredients for success, and 2) telerehabilitation as a viable form of stroke rehabilitation. The main themes and corresponding

categories (sub-themes) are provided in Table 2 [insert Table 2 here] and Figure 1 [insert Figure 1 here]. We provided illustrative quotes for each sub-theme, along with the participant's identification number and gender, age and time post-stroke (months).

TRAIL ingredients for success

Participants shared many factors that contributed to a positive and successful experience with the TRAIL program, which included strong support from family and peers, the expertise of the physiotherapist (PT), effective videoconferencing software, and the provision of comprehensive manuals.

Strong support from family and peers

Nine out of the 10 participants received a form of support from family members and/or peers ranging from verbal encouragement to overseeing the exercise sessions and assisting with technological set-up, which served as motivation to participate in TRAIL. P09 [Man (M), 47 years old, 5.7 months post-stroke] described the support from his roommate as motivation to exercise: *"I did all the exercises on my own and he [roommate] encouraged me... it's just verbal support, like, keep going on the exercises, you can do it"*. For other participants, family members were critical to their success and participation; interestingly, most were wives of participants identifying as men. P02 [M, 69 years old, 11.9 months post-stroke] stated *"I mean, I wouldn't have been self-motivated enough to do any of that on my own [reference to TRAIL exercises]. I mean, I would have – my wife would have pushed me"* and P08 [M, 72 years old, 11.3 months post-stroke] described that *"[wife] was involved 100% of the time"*, and *"that was the main thing"*.

Family members were also helpful in providing support for the initial technological set up, including downloading and logging into the respective platforms prior to the first session.

P01 [Woman (W), 54 years old, 10.7 months post-stroke] shared “*I’m technophobic - my daughter did a lot of it for me at the beginning*”, and P03 [M, 79 years old, 9.7 months post-stroke] reported that his wife managed the computer so that he “*didn’t have to worry about that*”. In contrast, one participant identifying as a woman (P010) shared her hesitation around seeking support from family members due in part to her daughter starting a new job, although it did not detract from her positive experience with TRAIL.

Peer support was also a positive factor related to participation in TRAIL. Four participants involved in this qualitative study had the TRAIL program delivered in a 2:1 participant-to-therapist ratio. The group format was well-received, with the peer participant seen as a source of motivation and friendly competition. For example, P06 [M, 60 years old, 17.6 months post-stroke] stated: “... *I thought it was a little bit of camaraderie. Not that we beat each other, well I did a few times, that sense of a team being part of something, I think that that does help. And also, the fact that there are persons there as well, you actually want to make sure that you do your part so you can be equal in your training*”. P01 [W, 54 years old, 10.7 months post-stroke] shared that “*we [her and TRAIL partner] got to a stage where we were competing against each other, but in a nice way. He was a lot older than me. He gave me incentive – I think that’s a good thing, having somebody younger and somebody older. Because you know, I thought if he can do it, so can I, do you know what I mean, when I was struggling right, though. So that was a nice thing*”.

Expertise of the Physiotherapist (PT)

The importance of the expertise and role played by the TRAIL PTs was evident in all interviews. All participants reported that balance exercises in TRAIL were challenging, particularly variations of tandem standing, but also noted that it was the modifications provided

1 by PT that were critical to their success with completing the program. P09 [M, 47 years old, 5.7
2 months post-stroke] shared “*I couldn't really do the tandem stand or the tandem walk. And then
3 also with the left arm, that's where [PT's name] came in handy, like with my bad left arm ... So,
4 you know, she's like, raise your one arm and do that. And, you know, at least she was getting me
5 through them the best I could*”. Participants appreciated how their PT ensured that the program
6 was individualized to ensure safety, allowing them to build self-confidence. For example, P09
7 [M] stated: “*She [TRAIL PT] was great, because she made me feel comfortable in the whole
8 thing. ..like she said, instead of doing it this way and risking a fall, try it this way, right. That's
9 why I said she was really good*”.

10 Participants also appreciated when the PT demonstrated the exercises and provided
11 verbal encouragement and corrections where necessary. P08 [M, 72 years old, 11.3 months post-
12 stroke] who was interviewed with his wife shared that “*She [TRAIL PT] was encouraging, she
13 showed how to do the exercises. She was pleased with the progress and let you know. She
14 corrected you if you didn't do the exercises properly*”.

15 Effective Videoconferencing Software

16 Participants reported that once the initial technological set up was complete, the
17 videoconferencing software platforms were user-friendly with few issues such as internet
18 instability, even with some participants living in rural areas. P03 [M, 79 years old, 9.7 months
19 post-stroke], who lived in a rural area, was the only participant that experienced technological
20 downtime that was brief and easily resolved, and did not detract from their experience with
21 TRAIL. They shared: “*Once my computer kept blacking out and I had to keep coming, leaving,
22 you know, things like that...but I could just trot over here and do my button here [indicates
23 Zoom[®] icon] and it would come back on... But that was the only glitch*”.

Participants reinforced that real-time, synchronous video communication with the PT was critical, and that an audio-only option would not allow the PT to demonstrate the exercises and observe the participants. P02 [M, 69 years old, 11.9 months post-stroke] noted that “*Zoom was sometimes difficult when I couldn't understand what my PT was saying. And I'm sure it went the other way too. But in terms of setup and the screen...I've got an 18 inch monitor, so that, you know, I could swing it around to the other - the kitchen's behind – the other room just, so I could just swing it around on the counter and she could see me, you know*”.

Provision of Comprehensive Manuals

The *Participant Manual*, *Exercise Manual*, and *Participant Exercise Log* were highly valued resources. Many participants validated the information provided in the *Participant Manual* for safety and positive engagement, noting that the suggested supports in their home environment (e.g., kitchen counter, chair with arm rests) increased their confidence in their ability to maintain balance in the virtual environment. For example, P010 [W, 67 years old, 6.4 months post-stroke] stated “*.. Yeah, I didn't have any problem that way.. I took advantage of being able to lean on a counter or whatever. And myself since my stroke, I've always felt very, very important that I didn't fall or injure myself*”.

The *Exercise Manual* was helpful for supplementing the visual demonstrations by the PTs, particularly during the independent self-managed exercise sessions. P04 [W, 80 years old, 6 months post-stroke] shared that “*Well, well, they [Exercise Manual] were well illustrated and describe each exercise. And sometimes I think, oh, am I doing everything? This exercise manual tells you what to do and I reviewed it. It was very good*”. Furthermore, the *Participant Exercise Log* was particularly valuable for tracking the self-management portion of TRAIL, providing a sense of accountability by tracking the number of sets and repetitions from the action plan to

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reinforce positive exercise behaviours. P03 [M, 79 years old, 9.7 months post-stroke] who was interviewed with his wife shared that “..*We wanted to get better. But of course, you know, with any exercise you get lazy, but this kept us on track...We had to decide when we were going to do our homework* [reference to self-management exercise sessions].. *But we always did them as much as we were supposed to. So being accountable is a big thing*”. P06 [M, 60 years old, 17.6 months post-stroke] stated “.. *and because it's written down there* [reference to number of repetitions for each exercise], *I found that good, and easy to follow*”. P01 [W, 54 years old, 10.7 months post-stroke] raised that the *Exercise Log* was particularly helpful to manage cognitive impairments she experienced after stroke, stating “*It [exercise log] gave you the motivation, and to be honest with you, the checklist helped, because you’ve had stroke your memory is not particularly the brightest, so it made sure you didn’t miss out on anything, that you were just following it and also as the weeks went past, you had different exercises you had to do so it wasn’t confusing*”.

Five participants mentioned that they continued to engage in modified TRAIL activities, even after the 4-week intervention program. P09 [M, 47 years old, 5.7 months post-stroke] shared “*I currently go through the TRAIL, but I don't get up to the speed that it was*”, while P01 [W, 54 years old, 10.7 months post-stroke] “*I'll be standing at the kitchen sink, and I'll go on to one foot, you know, to try to see how I'm doing*”.

Telerehabilitation is a viable option for stroke rehabilitation

Participants described many factors that contributed to telerehabilitation being a viable form of stroke rehabilitation, including its accessibility, abilities to extend rehabilitation opportunities into the community and address unmet rehabilitation needs.

Accessibility

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1 Being able to access real-time rehabilitation services without the need for travel
2 contributed to positive engagement and adherence to the TRAIL program. All participants were
3 able to successfully prioritize the TRAIL program around other roles or responsibilities at home
4 and in the community, particularly for participants living in rural areas or when experiencing
5 inclement weather. For example, P04 [W, 80 years old, 6 months post-stroke] stated that “*And*
6 *because of the isolation and so on of this winter, it was terrific. And [location] winters, it was*
7 *very easy for me to do it. I didn't have to go someplace else and park and you know, the whole*
8 *thing*”. Another participant living in a rural area which required a ferry ride to access the nearest
9 hospital, appreciated the accessibility of the telerehabilitation program.

10 Six out of the 10 participants described that their driver licenses had been suspended or
11 lost as result of their stroke but fortunately, the TRAIL program minimized this barrier to
12 accessing stroke rehabilitation services.

13 *Extends rehabilitation opportunities into the community*

14 Substantial variation was noted in terms of the duration and intensity of in- and out-
15 patient rehabilitation participants received, yet the TRAIL program extended opportunities for
16 community-based rehabilitation to all 10 participants. For example, P01 [W, 54 years old, 10.7
17 months post-stroke] shared that she completed 7 outpatient rehabilitation sessions with a PT, but
18 credited her improved health outcomes to the rehabilitation that she subsequently received in
19 TRAIL. P01 stated “*I wouldn't be where I am today or been able to do what I am today without*
20 *the [TRAIL] trial. And I'd say it's one of the best things, it basically gave me my life back*
21 *really... there's nothing that I can't really do within reason*”. P02 [M, 69 years old, 11.9 months
22 post-stroke] also shared “*I guess my point is if it had continued I probably wouldn't have to go to*
23 *physio and pay \$25 every session*”. In fact, all 10 participants expressed a common desire for the

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TRAIL program to extend beyond 8 synchronous sessions (4 weeks) in order to continue progressing with their stroke recovery.

While participants appreciated the specificity of TRAIL targeting their lower extremity impairments, half shared that they would have also benefited from exercises that targeted their upper-extremity impairments. When asked if any elements of the TRAIL program could be changed P05 [M, 65 years old, 15.8 months post-stroke], who experienced severe upper limb hemiparesis, shared “*Maybe I would change to stuff [exercises] that would help me with my arm*” while P06 [M, 60 years old, 17.6 months post-stroke] with moderate upper limb hemiparesis said “*... since lots of therapy out there tends to focus on the legs, it would be nice to see a little bit of a component for shoulders or upper limb. They tend to be left behind, in general*”. Thus, telerehabilitation programs combining both upper- and lower-extremity exercises may be perceived as the most optimal and viable for individuals with stroke.

Addresses unmet rehabilitation needs

There was a general consensus that face-to-face interactions with the therapist were preferred over telerehabilitation due to the importance of physical interaction provided during in-person care. P05 [M, 65 years old, 15.8 months post-stroke] noted: “*You seem to get more out of it when you're in person because the person is there. They can touch me*”. Nonetheless, all participants shared that the weekly progression in the TRAIL program was intensive, the exercises were challenging, and the outcome was substantial improvements in their lower extremity strength, balance, and mobility. For example, P09 [M, 47 years old, 5.7 months post-stroke] shared that “*I live in a 4 level house and I will come up from the basement level to the main level and I will go to kitchen table and I will sit down and the quad cane will be back sitting by the door. So I am walking and I am forgetting the quad cane everywhere. So my*

1 *walking has improved a lot from TRAIL*”, while P05 [M, 65 years old, 15.8 months post-stroke].
2 shared that “*She [PT] engaged me and in a way that, you know, helped me improve my mobility*”.
3 P03 [M, 79 years old, 9.7 months post-stroke] specifically mentioned that TRAIL contributed to
4 improvements in leg strength and allowed him to be able to get out of his chair, while P10 [W,
5 67 years old, 6.4 months post-stroke] shared that she benefited from being able to lift her leg
6 over the bathtub.

7 **Discussion**

8 We identified strong support from family and peers, the expertise of the physiotherapist
9 (PT), effective videoconferencing software, and the provision of comprehensive manuals as the
10 primary contributing factors to the positive experiences with the 4-week TRAIL program. We
11 also found that telerehabilitation appeared to be a viable form of stroke rehabilitation, due to its
12 accessibility, ability to extend the continuum of stroke rehabilitation, and address unmet lower
13 extremity rehabilitation needs.

14 Previous qualitative studies have also reported the importance of family and peers in
15 facilitating participation in telerehabilitation [15,43]. Telerehabilitation allows individuals with
16 stroke to engage in rehabilitation from their own homes, which in turn have provided
17 opportunities for greater engagement and support from friends and family members at home that
18 otherwise may not have been available during in-person programs. Thus, the virtual setting may
19 have fostered motivation to exercise, a key driver for positive long-term physical activity
20 behaviours among individuals with stroke [44]. Given the supportive roles of family members
21 and helpers observed in this study, future qualitative may consider exploring the perspectives of
22 family and peers of individuals with stroke participating in telerehabilitation programs.

1 The men and women who engaged in TRAIL in a group format (2:1 participant-to-
2 therapist ratio) enjoyed the sense of competition and camaraderie provided by their peer. This is
3 not specific to virtual settings; participants after stroke have expressed a preference to exercise
4 with others with similar conditions, as opposed to exercising with individuals that do not possess
5 lived experiences of stroke [45]. In fact, peer-support is a technique commonly used in self-
6 management programs for individuals with chronic conditions [46] with previous research
7 indicating that support from other individuals post-stroke is the most commonly reported
8 motivator for engaging in physical activity [44]. Group-based stroke telerehabilitation sessions
9 can reduce clinician use of healthcare resources by limiting the number and duration of sessions
10 offered [11] but, at the same time, can provide participants the opportunity to benefit from peer-
11 driven social support [44].

12 While previous work has demonstrated that therapists are skilled in transferring critical
13 motivational strategies from in-person to virtual forms of stroke rehabilitation [48], our findings
14 concur with others [49] that patient satisfaction is enhanced when therapists receive specific
15 training in telerehabilitation. Indeed, participants noted that TRAIL therapists played a critical
16 role by such as providing encouragement, correcting of movements, and progression or
17 modifications of exercises based on the individuals' physical abilities. These attributes are
18 consistent with published evidence supporting strategies of active listening, providing praise,
19 supporting enjoyable communication, provision of a suitable environment for effective
20 rehabilitation, and modifying exercise difficulty to promote satisfaction in, and adherence to,
21 stroke rehabilitation [50]. Importantly though, participants offered that the virtual environment
22 removed the ability for physical touch by the therapist, which has also been noted in other
23 synchronously exercise-based telerehabilitation programs [17]. In this respect, a hybrid model

combining in-person and concurrent, synchronously delivered virtual rehabilitation opportunities [48] warrants further attention.

It is encouraging that technological considerations related to the virtual nature of the TRAIL program were not perceived as barriers by participants in both urban and rural areas. This finding contrasts with earlier qualitative studies in which challenges with technology, such as high costs of equipment [16], connectivity issues [17], limited resources to consult in case of technological glitches [15,16,18,20] and interface-related problems (e.g., screen size and tablet placement) [17] have been reported as barriers to participation in telerehabilitation programs. We acknowledge that these previous studies predated the pandemic and likely used older technologies before advanced videoconferencing features in accessible and user-friendly format were widely available. Nonetheless, technological barriers are likely difficult to avoid completely, but a few strategies in the TRAIL protocol may have minimized these common challenges. The TRAIL team was able to mitigate barriers of high equipment costs and internet connectivity by loaning a study tablet and providing a videoconferencing account to participants with limited access to technology. This was particularly important for participants living in rural areas, where low digital literacy, reduced confidence and motivation to use technology, and lack of access to stable internet and other technological resources are more common [47,51]. As well, the 2 orientation sessions provided to each participant may have helped to alleviate some of the technological barriers reported in other studies.

In cases where communication over the videoconferencing software was challenging due to hearing or visual impairments, the *Exercise Manual* provided participants with an additional resource to consult for instructions and modifications/progressions of the exercises, while the *Participant Manual* provided guidance on the technological set-up. As also shown in our study,

1 individuals with stroke may benefit from technological support from family members [52], but
2 having other resources in place remains important to avoid relying heavily on support from
3 others, particularly for women who more likely to be widowed [53] or possess a belief of not
4 wanting to be a burden to others [37]. Indeed, the hesitation to seek support from family
5 members was observed with one female participant, in our current study. Overall, technological
6 barriers may be minimized when resources are accessible and account for the additional
7 considerations and challenges presented by individuals with stroke [54].

8 Not only were the study manuals helpful in mitigating technological challenges, they also
9 provided an additional source of accountability, especially for the self-management portion
10 where participants were required to self-monitor their action plans and exercise sessions. This
11 strategy was founded on evidence supporting the use of action planning and self-monitoring to
12 promote positive long-term physical activity behaviours and reduce sedentary behaviours among
13 older adults [55]. Programs such as TRAIL that aim to promote positive physical activity
14 behaviours beyond the duration of the intervention may be particularly important for women
15 with stroke who experience consistently poorer functional capacity than men with stroke over
16 time [56]. Encouragingly, participants identifying as women reported continued engagement in
17 the TRAIL exercises beyond the 4-week program. Overall, study manuals were beneficial for the
18 successful delivery and uptake of TRAIL, and thus we recommend that manuals be an integral
19 component of telerehabilitation programs. Clinicians may benefit from consulting newly
20 developed toolkits, which aim to share helpful resources and knowledge on the implementation
21 of telerehabilitation in individuals with stroke [57].

22 The accessibility of telerehabilitation, through limited need for transportation [17,20],
23 flexibility in scheduling [17], time efficiency, and cost savings [10], have been previously

Experiences of TRAIL after stroke

1 reported as facilitators for participation in stroke rehabilitation. In TRAIL, the primary factor
2 related to accessibility was transportation; a critical consideration given that 60% of our
3 participants experienced suspension of their driver licences and evidence that has shown that
4 70% of individuals between 3 months and 6 years after stroke do not return to driving [58]. The
5 accessibility of telerehabilitation may be particularly beneficial for older women with stroke who
6 may not have support for their transportation needs [37]; the logistical constraints around
7 coordinating transportation has been cited as one of the most substantial barriers to accessing
8 care for older women living in rural areas [59]. Telerehabilitation programs may also minimize
9 barriers to participation in stroke rehabilitation for women with primary caregiver roles by
10 offering greater flexibility in scheduling when travel time does not need to be accounted for
11 [37]. Further research is warranted to further explore the acceptability and effectiveness of
12 exercise-based telerehabilitation in a large cohort of women with stroke.

13 The improvements reported by all participants across a variety of domains of lower limb
14 recovery such as mobility, strength and balance are encouraging and important given that
15 balance and mobility are cited as the top priority areas for individuals with stroke [60,61].
16 Indeed, higher balance abilities and motor function are key facilitators for community
17 reintegration among individuals with stroke, a fundamental objective of stroke rehabilitation
18 [62]. Furthermore, self-reported improvements in physical disabilities may be clinically
19 meaningful and can play an integral role in increasing overall self-rated health after stroke [63].

20 Rehabilitation services are critical in the early stages of stroke to promote recovery [2]
21 and lower risk of institutionalization and dependence with ADLs [9]. Concerningly however,
22 less than 7% of individuals with stroke in North America are referred to [64] or receive
23 outpatient rehabilitation services [65]. In that regard, the TRAIL program addressed a service

gap by providing an opportunity to extend the continuum of stroke rehabilitation. Indeed, we noted the wide variability in course of in- and out-patient rehabilitation care that participants received, and in some cases, TRAIL was their first exposure to stroke rehabilitation services beyond limited in-patient care. Thus, our study adds to a growing body of evidence supporting the use of telerehabilitation when exposure to in-person stroke rehabilitation is not possible or limited [10,43,47].

Strengths and Limitations

This study has many strengths. We employed multiple sampling strategies that allowed us to interview individuals living in both rural and urban areas of Canada, as well as a similar representation of men and women with stroke. By employing these strategies, we were able to explore the positive aspects of the TRAIL program and the viability of telerehabilitation to support stroke recovery, while accounting for experiences of individuals in areas of the country where access to rehabilitation is limited. We were also able to consider, in a preliminary way, potential gender-based considerations that might have influenced participation in telerehabilitation. Moreover, the participants included in the qualitative study were representative of those enrolled in the feasibility study of TRAIL, with regards to age, time-post stroke, stroke severity, and lower extremity impairment. Overall, telerehabilitation was well-received by individuals with stroke in urban and rural areas, as well as both men and women. Thus, we are currently conducting a large-scaled randomized controlled trial (RCT) of the TRAIL program to establish its effectiveness at addressing lower extremity impairment among individuals with stroke. We hope that the findings from the RCT provide further insight into the widespread implementation of telerehabilitation for stroke recovery among men and women across Canada.

1 This qualitative study does present with limitations. First, our findings describe the
2 personal experiences and perceptions of individual stroke survivors and cannot be generalizable
3 to all individuals living with stroke. NIH-SS and mRS scores suggest mild to moderate stroke
4 severity; thus these findings may not be generalizable to individuals with severe lower extremity
5 impairment. Secondly, although we designed TRAIL with the intention to be delivered in 2:1
6 participant-to-therapist ratio to promote peer-support, slower recruitment rates experienced
7 during the COVID-19 pandemic limited our ability to offer group sessions to all participants in
8 the feasibility study. Third, we acknowledge that our study included a small proportion of the
9 population of individuals with stroke, where if we had a larger sample size, greater issues with
10 connectivity and internet instability may have been observed. Next, the current qualitative study
11 did not incorporate the perspectives of therapists that were involved in the delivery of the TRAIL
12 program. The clinical perspectives offered by therapists are critical to obtaining a better
13 understanding of the facilitators and barriers to the implementation of lower extremity-focused
14 telerehabilitation. We are in the process of analyzing data acquired from the TRAIL therapists.
15 Finally, interviews were completed at the end of the feasibility study. As a result, three
16 interviews were conducted close to one year after participants had completed the TRAIL
17 program, and thus potentially introducing recall bias.

18 **Conclusion**

19 The TRAIL program is a viable means of rehabilitation to enhance lower extremity
20 recovery after stroke by increasing access to stroke rehabilitation, extending the continuum of
21 stroke care, and increasing satisfaction with the services rendered. Synchronously delivered
22 telerehabilitation programs may be an acceptable alternative or supplement for community-based
23 in-person stroke rehabilitation, when therapists are trained to deliver virtual stroke rehabilitation

and comprehensive resources (e.g., exercise manuals) are available. Further research of exercise-based telerehabilitation is warranted to further understand its role in the stroke rehabilitation continuum, and inform policy and clinical guidelines on the use of telerehabilitation in practice. Additionally, research is warranted on the perspectives of informal caregivers who are involved in care of stroke survivors and their experiences with telerehabilitation. This exploration of the experiences of the TRAIL participants will inform future initiatives in the design and implementation of safe and effective stroke telerehabilitation programs.

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Declaration of Interest Statement

The authors have no conflicts of interests to declare.

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