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Group Tele-exercise for Individuals with Spinal Cord Injury: A Mixed Methods Pilot Study

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Abstract This pilot study used a mixed methods approach to determine outcomes of a group tele-exercise program to promote physical and psychosocial well-being (mood), quality of life (QOL) and enhanced physical activity for individuals with spinal cord injury (SCI). Eleven volunteers with SCI participated in virtual group exercise consisting of mind-body movement practice to build strength, fitness, confidence, and QOL. An experienced community exercise instructor and a trained co-leader with lived experience of SCI co-taught each session. Qualitative group interviews and quantitative measures of QOL, mood, pain interference and leisure time physical activity (LTPA) were obtained at baseline and 8-weeks. Increased QOL and reduced pain interference were found following the program, with moderate-to-large effect sizes for increased LTPA. Strong associations among pain interference, mood, QOL and LTPA change were identified. Our novel tele-exercise program demonstrated promise for utility to increase LTPA engagement while enhancing QOL and well-being in individuals with SCI.

Keywords: *virtual, physical activity, wellbeing, quality of life, spinal cord injury*

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1. Introduction

The age of onset and mortality of individuals with spinal cord injury (SCI) has increased into middle and older adulthood, creating an environment of aging *with* a disability, rather than aging *into* disability. The median age of SCI onset has increased by 14 years (2020: 43 years, 1970s: 29 years) with life expectancy reaching the eighth decade [1], yet there is minimal research on interventions to enhance the active, healthy years of life in this population. Lifetime health and wellness is important in personal management following SCI, yet there is minimal research on interventions to enhance the active, healthy years of life in this population. Purposeful exercise and increased physical activity participation are vital lifestyle behaviors for those living with SCI. Physical and psychological benefits of participating in physical activity following SCI are well established [2,3,4,5]; however, initiation and maintenance of these recommendations are difficult to achieve as demonstrated in those with long duration SCI. Physical activity participation directly impacts the bodily function and structures of individuals living with SCI. Physical inactivity can initiate and exacerbate secondary conditions that individuals with SCI are predisposed to including pressure sores, urinary tract infections, sleep disorders, and chronic pain [6,7]. These secondary conditions place individuals at risk for accelerated aging due to their negative impact on mental and physical health, chronic pain, and community engagement [8,9]. Longitudinal findings indicate that a progressive loss of health and function occurs over time with SCI, but longevity is related to activity and social participation [10,11]. Personal determinants (age, health status, motivation, attitude, pain, psychological barriers) and environmental determinants (accessibility of facilities, costs, transportation, social support/peer mentoring, healthcare professional knowledge) of physical activity have been identified in individuals with long duration SCI [12,13,14], indicating that there is an urgent need to develop lifestyle programs for this vulnerable population.

There are numerous psychosocial benefits for individuals with SCI who participate in physical activity. These include reduction of depression and negative mood, increased self-confidence, improved body image, and enhanced quality of life (QOL) [15,16,17]. Qualitative findings support these outcomes in individuals with SCI who reported that physical activity reduced depressive moods, facilitated optimism and positive outlook, and helped manage stress; thus enhancing overall psychological well-being and mental health [12]. Engagement in physical activity is positively associated with social QOL [18,19,20]. Participation created larger social networks [21] and increased social achievement [17].

Nearly 80% of individuals with SCI indicate that physical activity is important and express interest in maintaining an active lifestyle [22]. However, internal barriers such as motivation and negative perceptions of physical activity have a strong association with exercise participation [12,22]. Recent work has further elucidated that barriers to community-based exercise with SCI have been exacerbated by the isolation required to minimize deleterious effects of the COVID-19 pandemic (unpublished data). Psychological and social isolation is increased in individuals with disabilities compared to nondisabled peers [23]. These internal and external barriers highlight health and community inclusion disparities for individuals with SCI. Community inclusion provides people living with SCI equal access and opportunity to healthy living [24]. Telehealth, or internet-based healthcare services, improve social support and increase cost-effectiveness as compared to standard of care practices [25]. Telehealth has been cited as a successful strategy to mitigate SCI-related healthcare disparities and chronic health condition management [26]. For example, telehealth is an effective intervention to manage pressure ulcer development in SCI [26]. However, these findings are limited to case-based examination of healthcare provider clinical services. Evidence to support tele-interventions that also impact social engagement, such as group tele-exercise, is lacking. One small case-series demonstrated that participants with SCI valued group tele-exercise as a tool to overcome barriers to physical activity participation [27]. Therefore, the aim of this pilot study was to determine initial outcomes of a group tele-exercise program for individuals with SCI to promote physical and psychosocial well-being, QOL and enhanced physical activity engagement, utilizing a mixed methods approach. We hypothesized that participation in the 8-week tele-exercise program would improve QOL and level of leisure time physical activity and increased physical activity would be associated with reduced pain interference and improved psychosocial well-being.

2. Methods

2.1. Participants

This pilot study employed a mixed methods design (Figure 1). All aspects of the study were completed remotely due to the COVID-19 pandemic. Individuals with SCI were recruited based on existing local and national partnerships as well as through social media platforms (Facebook, Instagram) and the Drexel University webpage. Individuals were eligible for participation if they reported a complete or incomplete SCI of ASIA grade A, B, C or D; were at least 6-month post injury; ≥18 years of age and had internet access to participate in virtual exercise classes. Individuals were excluded from participation if they had a recent hospitalization (within a month), uncorrectable vision loss, preexisting neurological conditions other than SCI, and/or health conditions that preclude participation in physical activity. The protocol was approved by the Drexel University Institutional Review Board.

Following procedures review and providing informed consent, we obtained the following demographic data: age, biological sex (male, female), gender identity (male, female, transgender male, transgender female, gender expansive, not listed), race (American Indian/Alaska Native, Asian, Native Hawaiian or Pacific Islander, Black or African American, White, Hispanic/Latinx or Other), ethnicity (Hispanic/Latino, Non-Hispanic), educational level (<high school, high school diploma, vocational/trade school, some college, bachelor's degree, graduate degree, other), income level (<\$15,000, \$15,000-\$24,999, \$25,000-\$49,000, \$50,000-\$74,999, ≥\$75,000), injury level (cervical, thoracic, lumbar, sacral, other) and cause of injury (fall, motor vehicle accident, gunshot, medical/surgical, sports/recreational, another accident).

2.2. Intervention

Participant-Centered Tele-Exercise Program. The group tele-exercise class met twice weekly for 8-weeks. The intervention was developed and taught by a research clinician (LAB, a licensed physical therapist with extensive experience in adapted exercise delivery), and the trained co-leader living with a thoracic level SCI. An exercise physiologist and a community partner living with a cervical level SCI also consulted on the class design and delivery. A unique aspect of our program is inclusion of the co-leader with lived experience of SCI. The co-leader offered peer guidance and demonstrated lived translation of movement with an SCI. Classes were held over a HIPAA compliant web-based platform (Zoom™). The research clinician led the instruction of each class while our co-leader modelled movements alongside her and offer tailored modifications as needed. Each 45-minute class provided a comprehensive fitness experience to maximize functional independence and improve global physical activity engagement. Elements incorporated into each class session included a collective check-in and breathing meditation, postural control, trunk and shoulder strength, cardiovascular fitness, and body awareness. Necessary equipment (example: handheld or cuff weights, exercise bands) were delivered (by mail) prior to initiation of the tele-exercise class to maximize participation benefit. Procedural fidelity was ensured through a pre-determined class component checklist (example: breathing, mobility, stability, strength, cardiovascular training) and brief post-session reviews with the research clinician and co-leader with SCI. The class leader was available for private meetings with participants if requested.

Participant scheduling constraints limiting live participation were mitigated through class recordings being made available immediately post-session. Access to live-class recordings through Kaltura, a secure video content management system provided participants independent use outside of specific live class times.

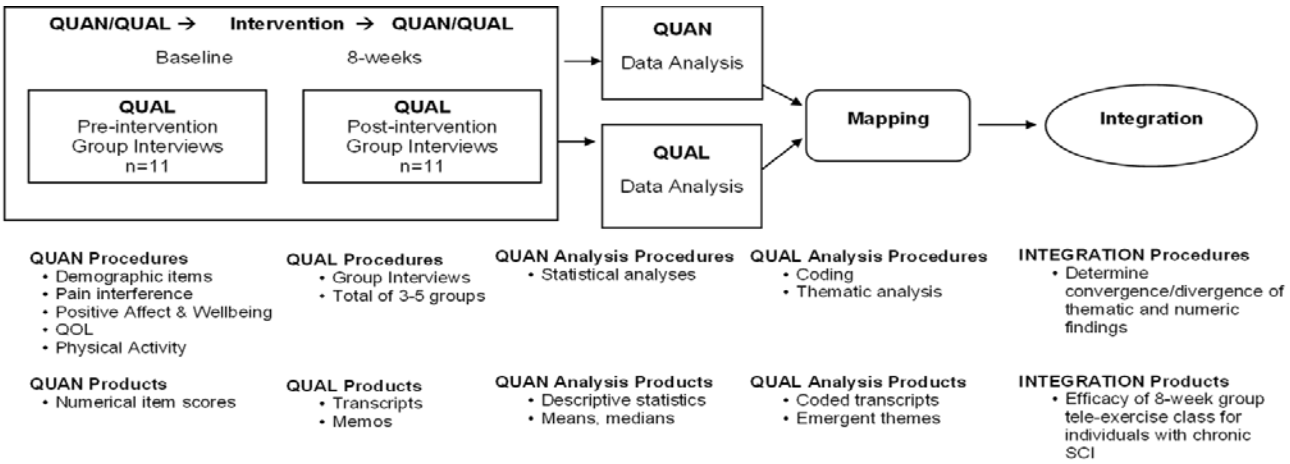

Figure 1. Parallel mixed methods desig

2.3. Study Measures

We identified relevant outcomes, balancing the need for a broad array of constructs that capture biological, psychological, and social aspects of physical activity participation for individuals with SCI while minimizing participant burden. These measures were recorded using both quantitative and qualitative methods and were collected at pre-intervention (baseline) and post-intervention (8-weeks).

Quantitative measures. Our pilot efficacy trial assessed four constructs identified in previous work (unpublished data) [28]: QOL, physical activity, pain interference and mood.

World Health Organization Quality of Life (WHOQOL-BREF) [29]: WHOQOL-BREF instrument is comprised 26 items, which measure the following broad domains: physical health (7 items), psychological health (6 items), social relationships (3 items), and environmental health (8 items), with two other items measuring overall QOL and general health. Physical health domain includes items on mobility, daily activities, functional capacity, energy, pain, and sleep. Psychological domain measures include self-image, negative thoughts, positive attitudes, self-esteem, mentality, learning ability, memory concentration, religion, and the mental status. The social relationships domain contains questions on personal relationships, social support, and sex life. Environmental health domain covers issues related to financial resources, safety, health, and social services, living physical environment, opportunities to acquire new skills and knowledge, recreation, general environment (noise, air pollution, etc.), and transportation. Each individual item of the WHOQOL-BREF is scored on a 5-point Likert scale from 1 (low score) to 5 (high score). The mean scores are then transformed linearly (multiplied by 4) to a 0–100-scale.

Leisure Time Physical Activity Questionnaire for People with Spinal Cord Injury (LTPAQ-SCI) [30]: The LTPAQ-SCI is an SCI-specific, self-report measure of leisure-time physical activity that assesses minutes of mild, moderate, and heavy intensity leisure-time physical activity performed over the previous 7-days. Test-retest reliability and criterion validity of the LTPAQ-SCI has been established [30]. Participants reported the number of days in the previous 7 days they participated in mild, moderate, and high intensity LTPA and the average minutes per day. Weekly totals were calculated (days*minutes).

Spinal Cord Injury Quality of Life Pain Interference SCIQOL-PI [31]: SCIQOL-PI short form (10 items) is a version of the PROMIS Pain Interference item banks, respectively, that have been optimized for individuals with SCI, reliably showing pain interference across a wide range of severity. Pain Interference raw scores were transformed to the PROMIS metric T-scores such that a score of 50 on either measure reflects the mean of the U.S. population. Higher SCIQOL-PI T-score indicates more greater pain interference. [31]

Spinal Cord Injury Quality of Life Positive Affect and Wellbeing SCI-QOL-PAWB [32]: The 10-item bank addresses aspects of a person's life that relate to a sense of well-being, life satisfaction, or an overall sense of purpose and meaning. SCIQOL-PAWB raw scores are standardized on a T-metric, with a mean of 50 and a standard deviation of 10 based on the SCIQOL calibration data such that a mean of 50 reflects the mean of an SCI population rather than the general population. Higher SCIQOL-PAWB T-score indicates a greater sense of positive affect and wellbeing.

Qualitative measures. Each participant joined one small group interview both pre- and post-intervention. Each small group interview included 3-5 participants and lasted approximately 60 minutes. Each session was recorded via Zoom web-based communication software and saved on an encrypted server. Open-ended guiding questions informed by pilot work and developed alongside a qualitative expert (GK) were collected prior to the intervention (unpublished data). The pre-intervention small group interviews, along with previous research findings (unpublished data) informed the delivery of the class such as scheduling constraints and addressed participant goals for the tele-exercise class. Post-intervention small group interviews provided information on participant satisfaction with the program and its delivery and included open-ended questions to complement the quantitative outcomes (pain, mood, quality of life, social participation, and leisure time activity, Table 1).

Table 1. Efficacy Measures by Quantitative and Qualitative Components

Efficacy Measure	Quantitative Outcome	Qualitative Complement
Physical Activity Level	Leisure Time Physical Activity (LTPAQ) [30]	Physical activity behavior
Quality of Life	World Health Organization Quality of Life (WHOQOL-BREF)[29]	Health and social satisfaction
Pain Behavior	Pain Interference (SCIQOL_PI) [31]	Pain intensity and interference
Mood	Positive Affect + Wellbeing (SCIQOL_PAWB) [32]	Sense of well-being, positive mood

2.4. Data Analysis

Descriptive statistics including means, standard deviations (SD), medians and interquartile ranges (IQR), or frequencies were determined for the demographic variables, as well as SCIQOL-PI, SCIQOL-PAWB, WHOBREF domains and LTPAQ. Parametric assumptions for continuous data were tested and numerous measures were not normally distributed, therefore nonparametric procedures were used for all analyses.

Within participant change over time (baseline to post-program, 8-weeks) was assessed with Wilcoxon singed rank test ($p \leq 0.05$). Cohen's *d* effect sizes were calculated and defined as small = 0.20, medium = 0.50, and large = 0.80 [33]. Change in total weekly minutes for mild, moderate, and high intensity as well as combined moderate and high minutes from baseline to post-program was calculated. Spearman rho (ρ) correlations examined associations of change in LTPA, WHOBREF overall QOL, health QOL, physical health, psychological health, and social relationships domains, SCIQOL-PI, SCIQOL-PAWB, as well as current age, age at injury and duration of injury. Strength of association (correlation) was defined as weak if $\rho < 0.30$, moderate for ρ=0.30-0.50 and strong when ρ>0.50 [33]. All analyses were performed in IBM SPSS Statistics for Windows, version 26 (IBM Corp., Armonk, N.Y., USA).

Thematic analysis was used to systematically identify key themes related to tele-exercise class participation. The reflexive steps include familiarization and transcription, code development, theme search, theme review, theme naming, and completion of report [34,35]. Small group interview audio recordings were transcribed via Microsoft Office Transcription software (Microsoft Office Version 16.48, 2021). Transcripts were manually cleaned and de-identified by one study member (LAB). Subsequently, the transcripts were reviewed with a second member of the team (MAF). The initial code book was developed among the study team, using *a-priori* concepts based on study objectives and the semi-structured interview guide. A second list of codes were generated based on emergent information that arose during interviews. Search and review of themes was completed collaboratively among three study members (LAB, MAF, GK) to ensure internal validity and reliability using Dedoose, a web application for managing, analyzing, and presenting qualitative and mixed method research data (Dedoose Version 8.0.35, 2018, Los Angeles, CA: SocioCultural Research Consultants, LLC).

Trustworthiness was established through reflexivity within and among the research team, triangulation with class co-leader, and expert peer-review of emergent themes by a co-investigator experienced in qualitative analysis (GK). Qualitative validity and rigor were embedded using the Consolidated criteria for reporting qualitative research (COREQ) to maximize reporting of findings [36,37].

A necessary component of mixed methodology is the integration of these distinct data types. Quantitative and qualitative data analysis were completed in parallel, with the intent to merge these data sets to be compared. This convergence of numeric and narrative findings yielded a comprehensive understanding of the impact of group tele-exercise as well as provided insights into future iterations of this pragmatic program [38].

3. Results

Eleven adult volunteers (biological sex/gender identification males=6, females=5, age = 49.5±16.7 years) with chronic SCI (duration of injury 2 to 32 years) participated. Nearly 55% of participants (6/11) reported cervical level injury with the most common injury mechanism being sports/recreation (45.5%), followed by motor vehicle accident (27.3). The majority of individuals identified their race as white (63.6%) followed by Hispanic/Latinx (27.3%). Over 45% of individuals reported an education level of bachelors or graduate degree, with another 45.5% reporting some college. Annual household income was reported at $25,000-$49,000 in over 45% of the sample. Table 2 and Table 3 show the demographic characteristics of the sample and participants, respectively.

Table 2. Demographic information of sample

Ethnicity	
Hispanic/Latino	n=3(27.3%)
Non-Hispanic	n=8 (72.7%)
Race	
African American	n = 1 (9.1%)
White	n = 7 (63.6%)
Hispanic/Latinx	n =3 (27.3%)
Education	
High school diploma	n = 1 (9.1%)
Some college	n = 5 (45.5%)
Bachelor's degree	n = 2 (18.2%)
Graduate degree	n = 3 (27.3%)
Annual Income	
<$15,000	n = 1 (9.1%)
$15,000-$24,999	n = 1 (9.1%)
$25,000-$49,000	n = 5 (45.5%)
$50,000 -$74,000	n = 1 (9.1%)
>$75,000	n = 3 (27.3%)

Table 3. Demographics of participants

ID	Age (years)	Age at injury (years)	Injury duration (years)	Injury level	Cause of injury
MC01	40	20	20	Cervical incomplete	Sports/recreation
MC02	26	20	6	Cervical incomplete	Motor vehicle accident
MC03	65	47	18	Cervical incomplete	Fall
MC04	70	38	32	Thoracic complete	Sports/recreation
MC05	23	16	7	Thoracic incomplete	Transverse myelitis
MC06	65	63	2	Thoracic incomplete	Brown-Sequard lesion
MC07	48	20	28	Cervical incomplete	Sports/recreation
MC08	50	32	18	Thoracic complete	Motor vehicle accident
MC09	41	20	21	Cervical incomplete	Sports/recreation
MC10	46	41	5	Thoracic complete	Motor vehicle accident
MC11	70	67	3	Cervical complete	Sports/recreation

Following participation in the tele-exercise program participants demonstrated a significant increase in overall QOL (p=0.02, *d* = 1.83) and physical health domain of QOL (p=0.02, *d*=1.86). Participant reported being inspired to do more physical activity outside of class time as stated:

"It really motivated me just to do something every single day, even if the class was only twice a week, I do something every day. Whether it's ride my bike stand or just get outside. I felt like I wasn't doing anything and then this really jumpstarted me doing something every day."

"As I said before, it's kind of spurred me on to be more physical. And physical health relates to mental well-being. They correlate, so like I say, whenever I do exercise, I feel better afterwards. I sleep better."

"I always got a really good night sleep after one of the workouts uhm and also just uh I feel like just really great with circulation."

A reduction in pain interference (p=0.04, *d*=1.64) occurred following the program. Participants described the increased activity during class as helpful for reducing the impact of pain:

"Yeah mine it helps because as I sit for long periods of time I get tight. My back gets tight, and the exercising again just help stretch it out and it'll alleviate some of my back pain."

"Not only did it help me relieve stress but lowered my pain levels 'cause I have nerve pain below the level of injury…."

Table 4. Association of post program pain, mood, quality of life (QOL) and change in leisure time physical activity (LTPA) weekly duration (Spearman's rho, p)

	Current age	Age at injury	Duration injury	Pain Interference	Positive Affect & Wellbeing	Overall QOL	Overall Health QOL	Physical Health Domain QOL	Psych Health Domain QOL	Social Domain QOL
Duration injury	-0.05	-0.47								
Pain Interference	0.13	0.09	0.12							
Positive Affect & Wellbeing	-0.55	-0.41	0.09	-0.23						
Overall QOL	-0.40	-0.48	0.40	-0.20	0.48					
Overall Health QOL	**-0.52**	-0.57	0.18	**-0.80**	**0.53**	0.38				
Physical Health Domain QOL	-0.03	-0.14	0.22	**-0.74**	0.30	**0.52**	**0.72**			
Psychological Health Domain QOL	**-0.58**	**-0.61**	0.24	-0.42	**0.70**	0.39	**0.63**	0.36		
Social Domain QOL	-0.13	-0.23	0.37	0.36	**0.55**	**0.60**	-0.09	0.14	0.31	
Mild intensity LTPA change	-0.13	-0.24	0.21	-0.13	0.40	**0.72**	0.12	0.25	**0.53**	**0.62**
Moderate intensity LTPA change	0.15	0.04	0.20	-0.08	0.26	**0.55**	-0.04	0.15	0.30	0.48
High intensity LTPA change	-0.19	-0.10	0.12	-0.33	**0.90**	0.48	0.46	0.41	**0.59**	**0.51**
Combined moderate + high intensity LTPA change	-0.14	-0.19	0.22	-0.33	**0.73**	**0.65**	0.46	0.47	**0.60**	**0.52**

Bold values = strong association (weak p < 0.30, moderate p =0.30-0.50 and strong p>0.50. [33])
Bold Boxes = strong, significant association p≤0.05).

Although not statistically significant, medium to large effect sizes were found for an increase in moderate intensity LTPA (p=0.39, *d*=0.51) and high intensity LTPA (p=0.11, *d*= 1.09). There was no change in the total minutes of LTPA per week, however there was a shift in intensity with a 19.3% increase in percentage of total time spent in high intensity and a 10.7% reduction in in mild intensity. Medium to large effect sizes were found improvements in health QOL (p=0.08, *d*= 0.51) and psychological health domain (p=0.42, *d*= 0.50) along with PAWB (p=0.39, *d*= 0.54). Strong, significant association were found among pain interference, mood, QOL post program (8-weeks) and change in level of weekly LTPA (Table 4). Change (increase) moderate and high as well as combined change in weekly minutes of LTPA was associated with higher mood (PAWB) and overall QOL, as well as psychological health domain and social relationships domains of QOL. Higher overall Health QOL was associated with less pain interference and higher physical health and psychological health domains of QOL. Older current age and older age at time of injury were associated with lower health and psychological health QOL domain while older current age also associated with reduced mood (PAWB).

The post-intervention small interview group findings strongly support the association on increased physical activity, enhanced QOL and positive affect and wellbeing (mood). Themes regarding learning new techniques from watching others and social interactions enhancing mood were evident.

> "It showed me that you know what? If I'm watching, you or somebody else do something. But there are other ways to get the same thing accomplished. But by watching you or the other person telling me you know hey, try this instead it made it easier. It made it easier for me to realize, you know what? Like anything else you. Just have to adapt to it differently."

> "You feel way better, like after you've done it. You feel way more motivated even afterwards."

> "So this version of it and being with other people with spinal cord injuries. I was excited to come to class every time, so it made me happy."

4. Discussion

This intervention was specifically designed to overcome physical and social barriers to exercise participation through distanced delivery (tele-exercise) with participant collaboration and a co-class leader living with SCI. Co-leadership with an invested stakeholder aimed centered the participant experience with the intention to increase engagement and decrease social stigma for exercise participation. The goal of this intervention was to facilitate physical, psychological, and social wellbeing while increasing leisure-time physical activity engagement in accessible, inclusive environment. Our hypothesis of increased leisure time physical activity engagement and higher QOL with a significant reduction in pain interference was supported. Along with increased leisure time physical activity, these pilot findings indicate an increase in overall QOL and a reduction in pain interference with moderate effect sizes for increased positive affect and wellbeing, physical health QOL and psychological QoL. The use of a parallel mixed method design has allowed us to support our quantitative findings with participant qualitative input.

Physical activity can reduce physical secondary conditions such as pain [6,7,16,39,40] and enhance psychosocial factors [12,18,19,21] in individuals aging with SCI. Participants in our program were 23-70 years of age with a wide range of injury duration (2-32 years). Many participants had been living with their injury for over half their adult life, while the two oldest participants had the shortest duration of injury. There was no association of current age, age at injury or duration of injury to LTPA (p>.05). Although the total minutes of LTPA did not increase, the current study found moderate to large effect sizes (*d*=0.51–1.09) for weekly moderate-high intensity leisure time physical activity following participation in our tele-exercise program. This increase in moderate-high intensity was coupled with a reduction in minimal intensity physical activity. The pragmatic format of the biweekly live class with access to recording allowed participants to maximize their engagement in the program, as one participant reported:

> "Myself, I do a minimum of at least 20 minutes a day. No matter what. I may not do the whole class, but I'll do the stretching for one. I'll do maybe like one day I'll do the stretching and I'll do bands, then the following one I'll do the stretching and I'll do the weights you know, I don't have time to sit for 45 minutes or 40 minutes every day. But I know I can do the 20…."

Based on the post program interviews, live class was preferred due to the motivational and social aspects, but recorded classes were important for facilitating ongoing activity participation allowing scheduling flexibility when live class attendance was difficult due to personal and professional conflict.

> "The recorded ones gave me the motivation, but I was driven by the live ones. I would tell people I can't do something because I had my class. And so the fact that it was on my calendar and I reserved that time, then I really looked forward to it. It gave me the motivation if I missed a class to be able to go back to the recorded one. Everything was driven for me personally from the live."

The inclusion of a co-leader living with SCI provided essential and directly translatable support. As stated by one participant:

> "So which is to me that that's the amazing part. You know most people can learn easily outside how to lift the weight and do that the right way, but it's there's extra techniques that you don't even think about, but they're so easy that you pick up is what I like."

Participants discussed that the class taught them new ways to exercise and motivated them to participate in activity outside of class time while enhancing mood, promoting better sleep, and alleviating pain.

Participation in the program improved overall QOL as well as physical and psychological QOL domains just as previous evidence has demonstrated [15,16,17]. Our qualitative findings align with previous work that participation in physical activity fosters a positive affect, provided stress management and improved overall psychological well-being and mental health [12]. As one participant stated *"Not only did it help me relieve stress but lowered my pain levels 'cause I have nerve pain below the level of injury*."

Physical activity participation is reported to create larger social networks [21]. It was clear from our qualitative interviews that participants experience enhanced social networks and enjoyed the interactions that occurred during the live class sessions. As stated by a participant *"Just to interact with other people even if it's only on Zoom, that's always a positive thing. I look forward to it twice a week."* Our lack of significant change in the WHOBREF social relationship domain is due to the limited scope of the three questions in this measure. In future work we will utilize a quantitative measure with a broader representation of social participation and engagement.

Although our sample is small, it is representative of the population at large. The sample represents diverse age, duration of injury, cause of injury, sex, and racial identification. Our mean pain interference score 52.1±9.3 (median 52.0, IQR 40.2-58.7) is similar to that reported in a larger study (n=757, mean 53.1± 9.5) [31]. Similarly, our baseline positive affect and wellbeing scores of 57.3±4.5 are comparable to those previously reported (mean 54.4± 7.2, n= 716) [32]. The significant reduction in pain interference following the 8-week program is an important finding. Eight participants reported pain interference with numerous aspects of their life at baseline, with 75% (6/8) reporting a reduction in pain interference ranging from 10.1% to 27.6% following participation in the tele-exercise program. Only two participants reported increased pain interference (<6% increase). Three participants reported no pain or pain interference at baseline and after 8-weeks, indicating participation did not induce pain in these individuals. These findings indicate the tele-exercise program facilitated a reduction in pain interference without inducing pain in most individuals, supporting the premise of physical activity participation reducing pain interference among those with chronic health conditions [41,42].

4.1. Limitations and Future Directions

As with any pilot study we must be cautious with interpretation of our findings as we are limited by our small sample size and lack of control group. However, the strong, positive participant response along with moderate-large effect sizes allow us to plan for larger, more definitive clinical trials of our unique program. To inform future pragmatic clinical trials, we performed a post-hoc power analysis with our smallest effect size (d=0.50) and learned that samples of at least 35 are needed to substantiate meaningful effects in those with SCI. We acknowledge that our scope of outcome measures was limited. However, the mixed method approach of this pilot investigation has allowed us more to clearly identify future constructs (sleep quality, satisfaction with social roles, etc.). Additionally, objective measures of physical activity levels are warranted. Furthermore, to assess the program more thoroughly, we will include different class leaders and co-leaders living with SCI in future studies.

5. Conclusion

Our novel tele-exercise program demonstrated its utility to increase leisure time physical activity engagement while enhancing QOL and psychosocial well-being in individuals with SCI. The inclusion of a co-leader living with SCI provided a unique benefit of peer support. Social engagement fostered motivation and enhanced participation. Future, larger clinical trials will further investigate the biopsychosocial benefits of program addressing more specific constructs related to physical activity engagement.

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