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Impact of Tai Chi on Peripheral Neuropathy Revisited: A Mixed-Methods Study

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Abstract

Exercise may be beneficial to older persons living with peripheral neuropathy (PN), but maintaining an exercise program is challenging. After participating in a 12-week tai chi (TC) study, 12 participants requested classes continue. A mixed-methods design was used to explore long-term engagement of older persons with bilateral PN enrolled in a TC class for 18 months beyond the original 3-month study. Pre- and posttest measures of functional status and quality of life (QOL) were conducted. Focus groups were held after 18 months of twice-weekly classes. Psychosocial support was critical to participants' long-term commitment to exercise. Participants reported, and objective assessments confirmed, increased strength, balance, and stamina beyond that experienced in the original 12-week study. Changes in QOL scores were nonsignificant; however, qualitative data supported clinical significance across QOL domains. Results from this study support psychosocial and physical benefits of TC to older persons.

Keywords

tai chi, older persons, peripheral neuropathy, functional ability, quality of life

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Introduction

Twenty million Americans face the challenge of living with peripheral neuropathy (PN; National Institute of Neurological Disorders and Stroke, 2018). Because of impaired sensation, pain, and reduced function, management of day-to-day activities is difficult. Causes of PN include infections, traumatic injuries, and metabolic problems; it is more common among persons with diabetes and chronic diseases. Diminished vascular function may also contribute to PN and the decline of physical function (Arce-Esquivel et al., 2016). Regardless of the underlying etiology, PN affects an individual's functional status and quality of life (QOL; Rath, Hermanns, Ballard, & Haas, 2017). The United Nations Sustainable Development Goal 3 (United Nations Department of Economic and Social Affairs, 2018) emphasizes the need to focus efforts on healthy living, particularly among populations that have been neglected. At this time, there is no cure for PN; however, exercise may prevent falls and related injuries. Current evidence has only focused on short-term exercise interventions (Ahn & Song, 2012; Huston & McFarlane, 2016; Streckmann et al., 2014). Attention needs to be

given to sustainable interventions that address PN among older persons.

Tai chi (TC), a mind-body exercise developed over 500 years ago in a remote Chinese village, combines martial art movement, breathing, and stretching techniques to achieve body harmonics (Wang, Chen, Liu, & Pearl, 2000). It has since become known more for its numerous health benefits. TC has been referred to as a "perfect" form of exercise because it is available to people of all ages and fitness levels and has an extremely low injury rate (Scutti, 2013).

While TC and other forms of exercise are reported to be effective in alleviating PN symptoms, increasing functional status, and improving QOL, attrition and maintenance of exercise programs continue to be a challenge (Schutzer & Graves, 2004). Nearly 80% of the

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general adult population do not meet physical activity guidelines (Centers for Disease Control and Prevention [CDC], 2014). Exercising with a chronic disease and its attendant symptoms provides additional challenges in adhering to an exercise program. Previous studies reported 12-week interventions (Ahn & Song, 2012; Streckmann et al., 2014). No studies were identified that examined long-term commitment among older persons with PN, representing a gap in the literature.

At the completion of a previous 12-week study by the authors, 12 of the 30 participants requested continuation of the TC exercise program. Eighteen months later, the group continued to meet twice weekly to participate in TC classes. It is unclear why this particular group continued to maintain an exercise program contrary to what is generally observed in older persons.

The purpose of this mixed-methods study was to explore long-term engagement of older persons enrolled in a TC class and assess their functional status 21 months after initiating exercise. The dominant qualitative strand explored participants' reasons for continuing the exercise program and perceptions of QOL; the quantitative strand assessed functional status and QOL. Specific research questions are as follows:

Among older persons with PN,

1. **Research Question 1:** What are the reasons for continuing to engage in TC?
2. **Research Question 2:** How do they perceive TC has affected QOL?
3. **Research Question 3:** What effect has long-term engagement in TC had on functional status and QOL?

Bandura's social cognitive theory (SCT) guided this study. The SCT posits a triadic reciprocal relationship among behavioral, personal, and environmental factors (Bandura, 1986; Bandura, 1998). In this study, "person" is represented by individual factors (demographics, functional status, and QOL) and psychological factors (self-efficacy). "Environment" refers to the external factors (group TC exercise classes) that either motivate or hinder a person's continued participation in the TC program. Motivational factors in this study are primarily centered around psychosocial support. "Behavior" refers to the commitment to adopt and maintain a certain behavior that will improve QOL. The behavioral outcome in this study is continued participation in a TC program for over 1.5 years. Based on SCT, the current study proposes that the psychosocial support (environment) found in a group TC exercise class (environment) contributes to long-term engagement in TC (behavior), which in turn leads to improved functional status and increased QOL (person).

Physical and psychosocial benefits of TC exercise have been extensively studied in a variety of populations (Frye, Scheinthal, Kemarskaya, & Pruchno, 2007; Lan, Chen, Lai, & Wong, 2013; Law & Li, 2014; Wu, Wang,

Burgess, & Wu, 2013; Zhang, Sun, Yu, Song, & Mao, 2015). Improvements were documented in persons with Parkinson's disease (Choi et al., 2013; Gao et al., 2014; F. Li et al., 2012), diabetes (Streckmann et al., 2014), cancer (Huston & McFarlane, 2016; Irwin et al., 2014; Wayne et al., 2017), and PN.

The regular practice of TC has shown positive results in people with PN who experience sensory and motor deficits that adversely affect balance (Huston & McFarlane, 2016). Ahn and Song (2012) concluded that 12 weeks of TC improved glucose control, balance, neuropathic symptoms, and some dimensions of QOL in diabetic patients with neuropathy. Streckmann et al. (2014), in a systematic review of 18 exercise intervention studies of patients with PN, concluded that TC was the best exercise for improving motor and sensory symptoms and balance.

Older persons are more prone to experience falls as they age, and the likelihood increases with concomitant PN (Richerson & Rosendale, 2007). In a 48-week cluster randomized controlled trial, Sattin, Easley, Wolf, Chen, and Kutner (2005) assessed fear of falling, fall risks, functional status, and falls in 311 study participants. Participants in the TC group improved significantly. The authors recommended TC be considered in any program designed to reduce falling and fear of falling in older persons. In a 3-month intervention study of 30 older persons with PN, the authors assessed the effects of TC on muscle strength, physical function, and QOL. TC significantly increased lower extremity muscle strength, physical function, and balance and significantly improved QOL.

It is unclear whether participants in the studies reviewed continued to perform TC following completion of the study. Attrition in exercise programs is often high among the older population (Schutzer & Graves, 2004). Nor is it clear what motivates older population to engage in long-term exercise. Few studies considered older participants' perceptions of TC benefits or explored their experiences of engaging in TC.

Method

A mixed-methods convergent parallel design with dominant qualitative strand was used to assess the long-term impact of TC on PN among older participants. The qualitative strand explored how TC affected participants' QOL. The quantitative strand examined the effect of TC on functional status and QOL. The rationale for this design is that assessing both subjective and objective indicators provides a more comprehensive perspective of the QOL for participants living with PN.

Qualitative Measures

Focus group sessions, conducted at the university, were guided by a general question; prompts were used as needed to elicit rich, thick descriptions of overall QOL well-being.

Quantitative Measures

Muscle strength. One-repetition maximum (1-RM) was conducted on weight machines (i.e., Life Fitness) designed for lower body (i.e., leg extension, leg curl) muscle groups. Participants lifted the heaviest weight they could within their comfort level one time. To eliminate interobserver variability, the same investigator performed these procedures before and after training.

Functional exercise capacity. A Six-Min Walk (6MW) test was administered using a standardized protocol (American Thoracic Society, 2002). Participants were instructed to walk at their own pace on an indoor track for 6 min covering as much distance as possible. Distance traveled in 6 min was recorded to the nearest meter.

Functional mobility. Timed Up-and-Go (TUG) was used to assess functional mobility using an established protocol (Podsiadlo & Richardson, 1991). Participants were seated with back against a chair and feet on the floor with a cone 3 m in front of the chair. Participants stood up, using arm rests if needed, walked around the cone, and sat with back against the chair. Timer was started on the word “go” and stopped when participants’ backs touched the chair. Two separate trials were averaged for the TUG score.

Fall Risk Balance test. The Biodex Balance System SD, tested and shown to be valid and reliable for older persons (Parraca et al., 2011), was used to assess balance and postural stability. The Biodex Balance System SD uses a circular platform free to move in the anterior–posterior and medial–lateral axes simultaneously. During the test, participants stood on the middle of the platform with feet shoulder width apart and were instructed to maintain center of pressure in the smallest concentric rings (balance zones) on the monitor on the Biodex Balance System SD. Placement of the toes and heels on horizontal and vertical lines was recorded to allow for repeat testing. Participants were asked to maintain an upright standing position for 20 s without touching the handles for assistance. To maintain balance, participants were required to perform weight shifts to keep a dot in the center of the screen. A minute break occurred between each of three trials. Result of the trials is given as a stability index which compares the participant with age-dependent normative data. Scores higher than the normative values suggest poorer balance, whereas scores below normative values suggest better balance.

QOL. The Functional Assessment of Cancer Therapy–General (FACT-G), Version 4, was used to assess QOL. The FACT-G, a 27-item instrument with four QOL domains (Webster, Cella, & Yost, 2003), has been validated in numerous chronic illnesses and in the general

population. Each item is rated on a scale ranging from “0” (“not at all”) to “4” (“very much”). Items are reverse scored as indicated, summed, multiplied by number of items in the subscale, and then divided by the number of items answered. Subscale scores range from 0 to 24 (Emotional Well-Being) and 0 to 28 (Physical Well-Being, Social/Family Well-Being, and Functional Well-Being). Subscale scores are summed to provide a total FACT-G score. Higher scores are indicative of better QOL. Reliability and validity have been established in numerous studies. Internal consistency of the FACT-G total scale has been established ($\alpha = .89$).

Sample and Setting

A convenience sample of 12 participants (seven women and five men) with bilateral PN, engaged in a TC program for 21 months (3 months in original study and 18 months following conclusion of the original study), took part in this study. Older participants (≥ 60 years) ranged in age from 64 to 80, with a mean age of 74.5; most ($n = 8$) were married. The majority were Caucasian with one African American; all were non-Hispanic. Participants were highly educated; all had completed high school with nine reporting baccalaureate or graduate degrees. All but one participant were retired; the majority ($n = 8$) reported annual incomes greater than US\$51,000. Participants had lived with neuropathy between 3 and 20 years, with an average of 13.3 years. Participants reported that neuropathy was related to diabetes mellitus ($n = 1$), degenerative joint disease or trauma causing nerve compression ($n = 3$), heredity ($n = 1$), or drug therapy ($n = 2$). Several ($n = 5$) reported idiopathic neuropathy. One participant was excluded from final quantitative analyses due to missing baseline data from the original study; another was unable to attend the focus group, resulting in a final sample of 11.

Intervention

The progressive TC Yang Style program has continued 2 times per week for 60 min for 21 months. A typical TC practice session includes diaphragmatic breathing and gentle stretching exercises for warm-up (10 min), learning and practicing TC Yang Style (45 min), and cool down (5 min). Classes have been led by the same TC master who initiated the TC program at the university. Other well-trained individuals were present to observe and ensure safety among the participants. Participants were also encouraged to practice TC at home once a week.

Procedures

Following institutional review board approval (SP2017-43), participants were informed of the study at the conclusion of a regularly scheduled TC class and invited to participate. Following written informed consent, study

participants were assigned a number identifier to ensure confidentiality.

Qualitative arm. Two focus groups with five to six participants per group were conducted concurrently with follow-up quantitative assessments. Prior to the focus group, the FACT-G was administered using paper-and-pencil surveys and reviewed for missing data. Focus groups were held in a private room on the university's main campus and audio-recorded using a digital recorder. Senior researchers served as co-moderators, establishing an informal and open atmosphere to encourage free-flow discussion. The primary moderator directed the discussion, while the assistant moderator made comprehensive notes (what was being said as well as nonverbal communication) and facilitated as needed. A trained research assistant (RA) served as the scribe writing key points for each question. At the end of each focus group, the assistant moderator summarized the key points of the discussion and asked for clarification or correction by the participants.

Quantitative arm. Assessment of physical function was conducted in the university's wellness center in accordance with American College of Sports Medicine (ACSM; 2010) guidelines. Assessments were conducted over two visits in the same week as the focus groups were held. At visit 1, the TUG, 1-RM leg curl, and 1-RM leg extension were conducted. At visit 2, Fall Risk Balance test and 6MW test were evaluated. Data were entered into SPSS version 24.0 for data analysis.

Data Analysis

Qualitative Analysis

Qualitative description was utilized (Sandelowski, 2000) and the constant comparative method (CCM) as described by Glaser and Strauss (1967) was used throughout the data analysis process. The CCM is a process in which each item of data is compared with all other items within the individual data set, and compared with data items within the group, which allows a defined pattern or gestalt to emerge from the data.

Transcripts were transcribed verbatim and reviewed multiple times to identify categories and emerging themes to understand the participants' reported impact of TC on QOL and physical function. Categories and themes were verified by two expert qualitative researchers. Researchers' notes were examined and added to the transcripts. Trustworthiness was established through the use of participants' own words, thick description, neutrality (researchers did not provide the intervention), and an audit trail.

Quantitative Analysis

Descriptive statistics were used to assess and report demographic data. Participants' final scores on physical function measurements and the FACT-G from the

original study were compared with participants' QOL and functional status measures following the additional 18 months of TC classes. Given the small sample size, nonparametric Wilcoxon signed-rank tests were used to assess changes in functional status and QOL.

Results

Qualitative Findings

Two themes, psychosocial support and physical improvement, emerged. Psychosocial support was multifaceted and indicated a sense of community experienced by this group. Terms such as "encouragement and support," "bonding and camaraderie," change of "mental perspective," and "spiritual" all evidenced the unique sense of caring that was the driving force for long-term engagement in these TC classes. Physical improvement included balance, strength, and sleep.

Psychosocial support

Encouragement. As participants arrived, they immediately began greeting each other with joyous calls of "how are you?" and hugs. It was apparent this was not a "research focus group"; it was a celebration. A gathering of friends, strangers just 21 months prior, had bonded into a cohesive group that truly liked, cared for, and encouraged each other and was evident in the discussion that followed:

You get a lot of encouraging camaraderie from the group as well as the TC master, yes, he encourages us. And then he knows we're doing, some days, as best we can. It's not always pretty, but it's still, we're out there doing it . . . (Participant A)

I enjoy the camaraderie . . . (Participant B)

He [instructor] tells us after every movement that we're trying to learn and when we go—we're all doing so bad, we're all on a different page—and he says, "Good, good!" [Laughter] Every time, he stops and he'll be, "You're doing good. You're doing good." And we know we're not. [Laughter] It's really great to hear that. (Participant C)

Another participant (Participant D) explained encouragement in this way:

Uh, the mind, the body, the environment and he, that's how he makes me feel. You know, I feel like I'm a part of a movement. And so, yes, it's spiritual, to me. And it fills the emotions. You're totally involved and you commit to the movement . . . the encouragement.

Participant A added, "And I think that [e.g., encouragement and support] makes a huge difference, not only, I think he [instructor] enjoys to see us delivering. That makes us feel good that we accomplished that during that period of time." The encouragement and support extended beyond the classroom as evidenced by Participant C's comment:

We . . . e-mail each other. If we have people who aren't showing up regularly . . . We find them either on Facebook or e-mail to see what's going on with them and why they're not here. We worried about you when you were out for a while. We missed you.

Participant E elaborated further:

For me it's a combination of the people for one, then two, the instructor and Dr. (Name) as well. Always easy to ask Dr. (Name) and him a question. They answer it very thoroughly and always appear to really have your interest at heart.

This lively group of exercise friends encouraged and supported each other not only in the TC classes but also outside of the classroom. Their upbeat humor was evident in their remarks and discussion, but they were also serious about the PN that was the impetus for them to join the original TC PN research study and the positive results they have experienced during this time.

Bonding and camaraderie. While there is no cure for PN, participants found ways of coping and learning to live with PD through the beneficial effects of TC and the camaraderie that created a special bond in this group:

The bonding helps us deal with the neuropathy even though we know it's not curable. If somebody came in and felt this was going to be a cure and I'll never have it again, that's possible, but I think what we've experienced, I believe, is that it helps us live with it. And it strengthens us in other areas of our body that allows [us] to live through the fact that we have the numbing of the feet and the pains that go with it. (Participant F)

Participant B echoed Participant F's sentiment, stating,

I enjoy the camaraderie that I find there. We all share a common denominator. We're all in this together and you know it's nice to share and know that other people are going through it and having the same kind of issues, . . . I take TC whenever I can.

Change of mental perspective. Others commented on the benefits of TC on mental status. "From a mental perspective, it's also, like you say, relaxing to get into it. But it also stimulates your brain to learn something different" (Participant G). Participant E supported the premise, stating, "I think a lot of it, too, is the fact that it kind of clears your mind. Everything external is gone. You're just exercising. It's quiet, smooth . . ." Participant H added, "It's concentration."

Spiritual. Another finding that confirmed psychosocial support was a spiritual aspect that was evident during the focus groups. Lorraine shared, "And I love the group. We look forward to seeing everybody. We truly care about these people. They're in our prayers. We really look forward to seeing them." Participant I added,

Well yeah, I'm a retired minister and chaplain and I just love all these people and when somebody is ill, we pray for them and, you know, send cards. We send cards to people because they're not here for some reason, they can't make, meet the meeting, just to tell them we miss them.

Physical improvement. When asked how TC affected their QOL, participants stated physical improvement kept them returning to the classes. While many of the participants stated that TC did not help the neuropathy itself, it did improve their symptoms. The physical improvements shared among the group included the following:

Dr. (Name) says it's the three things that you're gonna need to extend your life: strength, endurance and balance. So, it has all of those things and he's right . . . I want to be able you know to walk outside, have my balance. I want to dance, so those three things are things that I'm working on. (Participant D)

Balance. Participant H added, "Tai chi hasn't helped my neuropathy . . . but it has helped my balance. I like it because it's helped my agility. I feel like my balance has improved." Lorraine confirmed Participant H's observation, stating, "Well, it has not helped my neuropathy at all, but has definitely made a difference in my balance because I'm more sure-footed than I ever was." Participant F agreed,

For me, the only thing . . . it hasn't fixed the neuropathy. It's not going to do that. We know that. But before I started TC I couldn't stand up and put on a pair of socks. Now I can stand on one leg. And it makes a world of difference. And so now, even though I can't feel my feet except for pain once in a while, I climb ladders and I do all the things that I had done before.

Participant D explained how physical improvement from TC has prevented injury: "It shows up, you know, when you almost fall and you catch yourself, you know. I know that that's miraculous for me, you know. I had this knack that I was a person who fell all the time." Participant K elaborated,

Well, my balance has improved a great deal. Now and then my feet still can go and get numb. I don't know that that has changed. I do feel that my balance is significantly better than it was before. I don't know about my strength a whole lot. I can't really tell in that. But balance is always a concern. It's much better than it was before.

Participant I commented,

Yeah, I agree that it didn't help my neuropathy, but it has helped my balance, mostly balance, and strengthened my legs. I went to the doctor the other day, oh just about a week or two ago, and he told me, he said, "Tai chi will not help your neuropathy." He told me, he said, "But what it does is it gives you a sense of, sensory, through your eyes to keep your balance, and that's the good of TC."

Table 1. Wilcoxon Signed-Rank Scores of Physical Function Assessments Over Time.

Measure	Pretest <i>Mdn</i> (<i>n</i> = 11)	18-month posttest <i>Mdn</i> (<i>n</i> = 11)	<i>z</i>	<i>r</i>
Muscle strength				
1-RM leg extension (kg)	18.14	31.82	2.934	.63**
1-RM leg curl (kg)	24.02	36.36	2.936	.63**
Functional exercise capacity				
6MW (m)	368.50	456.29	2.934	.63**
Functional mobility				
TUG (s)	9.78	8.40	-2.934	-.63**
Fall Risk Balance	2.50	2.30	0.890	.19

Note. 1-RM = one-repetition maximum; 6MW = Six-Min Walk test; TUG = Timed Up-and-Go.

***p* ≤ .005.

... my balance is better so I do still bend over some but not a great deal. But walking was the better, you know, stepping off a curb or, you know, I'm still kind of hesitant to do it at times, but I really watch that to walk ... where I'm walking. Because if you step on a stone, I mean, it'll throw me off. (Participant B)

Strength. Several participants stated that TC increased their physical strength and endurance. Participant E shared a specific example: "... and I could only lift 50 pounds and press down 50 pounds. After the 12 weeks, I went up to 90 pounds. It helped my strength." Participant B commented, "... I have energy. I seldom ever say I'm tired unless I've really been digging in the flower bed, I mean really working. Otherwise, I'm energetic for the most part."

Sleep. Improved sleep was reported by participants. Participant G commented, "So, to get to the point where I'm sleeping, I'm actually in that bed like seven hours, feels mighty good ..." Participant C elaborated,

I tend to not be able to go to sleep because my knees tend to be pretty tense, but if I do TC before bedtime, I find that it relaxes me and has me not focusing on the day but focusing on my breathing and trying to remember the 24 forms. [shared chuckles] And it does help me to get to sleep faster and I sleep better ... And like, it's become an integral part of our lives now. I think, speaking for me, I do a routine. I don't practice because I know I'm gonna be coming back and I don't want to look like an idiot. I practice because it helps me sleep. I practice for an hour because I'm in the middle of a stressful mood and if I don't do my TC I would probably kill my husband. [laughter] So, it's a legal stress relief ... But it is just a part of life. It's something that you do and I do it for me. And it doesn't require a lot of equipment. It doesn't require a lot of space. It's funny looking to people who don't know what you're doing, but I don't care.

Participant H summarized the physical benefits of TC with the sentiment

... What we've experienced, I believe, is that it helps us live with it [PN]. And it strengthens us in other areas of our

body that allows [us] to live through the fact that we have the numbing of the feet and the pains that go with it.

Because of the numerous improvements the participants experienced from the TC exercises, they continued to engage and incorporate TC in their daily lives. The improvements were overwhelmingly beneficial to their physical and psychosocial well-being. Testimonials comparing living with PN prior to the TC program to now living with PN and engaging in TC further illustrated the overall improvements.

Quantitative Findings

Muscle strength. Wilcoxon signed-rank test was used to report changes in all functional assessments. The average values for lower body muscular strength are presented in Table 1. Following the additional 18-month TC exercise program, lower muscle strength increased significantly among the participants. This improvement in muscle strength was in addition to the significant changes observed in the original study.

Functional exercise capacity. The baseline 6MW test median was 368.50 (Table 1). Following the TC exercise program, distance covered in the 6MW increased significantly. This improvement in functional capacity was in addition to the significant changes observed in the original study.

Functional mobility. Baseline TUG median score was 9.78 (Table 1). The TUG decreased significantly following training, indicating improved functional mobility. This was in addition to the significant changes observed in the original study.

Fall Risk Balance. Scores for the Fall Risk Balance test improved from 2.50 to 2.30; the change was not statistically significant.

QOL. The FACT-G posttest total sum score was not significantly higher than baseline (Table 2). The small effect size represented a nonsignificant change in overall QOL

Table 2. Changes in Quality of Life Over Time.

FACT-G scale	Pretest <i>Mdn</i> (<i>n</i> = 11)	18-month posttest <i>Mdn</i> (<i>n</i> = 11)	<i>z</i>	<i>r</i>
Physical Well-Being	25.00	23.00	−0.630	−.13
Social Well-Being	26.00	23.00	−0.423	−.09
Emotional Well-Being	22.00	22.00	−0.604	−.13
Functional Well-Being	22.00	23.00	−0.238	−.05
Total quality of life	94.44	87.00	−0.664	.14

Note. FACT-G = Functional Assessment of Cancer Therapy–General.

Table 3. Comparison of Qualitative and Quantitative Findings.

	Qualitative	Functional assessment	FACT-G
Physical Well-Being	Clinically significant	Significant	Nonsignificant
Social Well-Being	Clinically significant	NA	Nonsignificant
Emotional Well-Being	Clinically significant	NA	Nonsignificant
Functional Well-Being	Clinically significant	Significant	Nonsignificant

Note. FACT-G = Functional Assessment of Cancer Therapy–General.

scores. Similarly, FACT-G subscale findings supported that long-term engagement in TC exercise class did not have an added significant effect on participants’ physical, social, emotional, or functional QOL.

Comparison of Qualitative and Quantitative Findings

As a final comparison, qualitative findings were compared with quantitative measures (Table 3). Qualitative data portrayed a different result than quantitative data. While results of the quantitative measures were mixed, the qualitative findings were clinically significant.

Discussion

In contrast to the low percentage of persons engaging in physical activity as reported by the CDC (2014), the commitment of this group to continue to participate in TC was unique. It was at their request the TC program continued. In response to Research Question 1, qualitative findings revealed psychosocial support from other participants and the instructors as a driving force for their long-term engagement in the TC classes. These findings suggest the importance of social networking and psychosocial support for older persons as a means to keep them engaged in exercise. These findings reinforce the tenets of SCT (Bandura, 1986), which predict the influence of environment (represented by psychosocial support in this study) on behavior.

Research Questions 2 and 3 explored the qualitative and quantitative impact of TC on QOL. Contrary to the nonsignificant quantitative findings, qualitative data suggested physical and psychosocial QOL improved over time. Participants credited increased strength, improved balance, and strong sense of camaraderie among group members as contributing to an improved

QOL. These findings support the premise of SCT that environment (i.e., group TC exercise classes) influences both person (QOL) and behavior (long-term participation in exercise).

Initial review of the FACT-G scores seemed to indicate a discrepancy between the qualitative and quantitative assessments of QOL. While self-reported QOL subscale scores indicated little change or a slight decrease, none was significant. However, baseline measures for this study were taken after a 12-week intervention. QOL scores significantly improved over time in the original study. The fact that QOL did not significantly change suggests this is a sustainable improvement. Another consideration is that the QOL scores were quite high at baseline and there may have been a ceiling effect.

Research Question 3 also addressed the effect of long-term engagement in TC on functional status. As reported in previous studies (Arce-Esquivel et al., 2016; Lan et al., 2013; Law & Li, 2014; Wu et al., 2013; Zhang et al., 2015), findings of this study support the overall benefits of TC. Functional assessments demonstrated statistically significant improvement in muscle strength and functional exercise capacity over 18 months. It is noteworthy that these significant improvements were over and above the significant findings reported in the original study (Arce-Esquivel et al., 2016). These results suggest that long-term engagement can lead to continued improvement in functional status of older persons.

Although sensory nerve testing was not conducted as part of this study, qualitative findings indicate PN remained unchanged. Participants in this study agreed TC is not a cure for PN; however, TC did improve balance, flexibility, and strength. Findings corroborate other studies that reported improvement in functionality in persons with PN (Richerson & Rosendale, 2007; Sattin et al., 2005; Streckmann et al., 2014). This study highlights the importance of TC as a form of exercise for

participants with PN and supports findings from Frye and colleagues (2007) who also demonstrated functional and psychological improvement. Findings also support TC as a safe and effective exercise for persons with PN (L. Li & Manor, 2010).

Limitations and Strengths

Homogeneity and small sample size limit study power and generalizability of the findings. This self-selected sample may not be representative of the general population experiencing PN. The study length of this TC program is 21 months, addressing concerns expressed over the time spent learning versus doing TC (Frye et al., 2007). The mixed-methods design was an additional strength of this study.

Implications for Practice

Results from this study support the psychosocial and physical benefits of engaging in TC. Findings also suggest that TC is easily tolerated, safe, cost-effective, and enjoyable for older persons. Health care providers are encouraged to consider prescribing TC as a physical activity for older patients with PN. Group classes comprising patients with similar conditions are specifically recommended as the psychosocial support from others was instrumental in participants' continued engagement in TC.

Conclusion

Engaging older persons in a group exercise class is instrumental to their commitment to continue a program of exercise. Participating in TC over an extended time frame may maintain QOL and/or continue to improve psychological and physical functioning. TC appears to be an effective and feasible mind-body exercise for the older population with PN.

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Declaration of Conflicting Interests

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