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Tai Chi Exercise on Muscle Strength and Physical Function in Peripheral Neuropathy Patients
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ABSTRACT
An estimated 20 million people in the U.S. suffer from peripheral neuropathy (PN). Patients with PN develop gait abnormalities. Foot pain is one of the factors affecting walking ability. As a result, a large number of individuals with PN suffer from a reduction in daily physical activity and reduced quality of life. Tai Chi appears to be safe and effective in promoting strength and functional capacity in older patients with other chronic disabilities. Purpose: This study aimed to assess the effects of Tai Chi on muscle strength and physical function in patients with PN. Methods: Thirty seven patients (men=21, women=16) were randomly assigned to either Tai Chi exercise (Ex, n=20) or control group (Con, n=17). All participants signed informed consents prior to testing. Exercise Program: Exercise consisted of 12-week progressive Tai Chi (i.e., Yang Style), offered 3 times per week, 60 minutes each time. A typical Tai Chi practice session was 60 minutes long, included diaphragmatic breathing and gentle stretching exercises for warm-up (10 min), learning and practicing Tai Chi. Assessments: One Repetition Maximum (1RM): One RM was conducted on weight machines (i.e., leg extension, and leg curl) muscle groups. Participants were asked to lift the weight one time as heavy they were able to lift within their comfort level. Time of 8 Foot up and Go (TUG): This test was used to assess agility, coordination and dynamic balance. The test requires standing up from a chair, walking eight feet, turning and walking back to the chair as quickly as possible. Six minute walk test (6MW): Participants were instructed to walk at their own pace trying to cover as much distance as possible in 6 minutes on an indoor track. To standardize the protocol, the participants were not coached during the test, but made aware of time remaining to completion. The distance covered was recorded to the nearest meter.

INTRODUCTION
An estimated 20 million people in the U.S. suffer from peripheral neuropathy (PN), a pathology associated with damage to peripheral nerves that results in loss of function, amputation, and decreased quality of life (QOL). Patients with PN develop gait abnormalities, balance and mobility problems. Foot pain is one of the factors affecting walking ability. As a result, a large number of individuals with PN suffer from a reduction in daily physical activity and reduced QOL. Indeed, patients with PN exhibit lower scores on the functional reach test (Duncan et al. 1990), the 6-min walk test (6MW), and the Timed Up-and-Go (TUG) (Manor and Li, 2009) compared with age-matched controls. Furthermore, people with PN, typically, do not perform a lot of physical activity due to their limitations.

Considering the gait and balance challenges associated with PN, low velocity, low impact exercises might be the most effective for this clinical population. Tai Chi, is an ancient Chinese healing/martial art that consists of a series of graceful movements with deep and slow diaphragmatic breathing. Tai Chi training appears to be safe and effective in promoting balance, strength, and functional capacity in older patients with chronic disabilities (Song et al. 2003, Wang et al. 2004). Thus, the purpose of this study was to assess the effects of Tai Chi on muscle strength and physical function in patients with PN.

METHODS
Participants
Thirty seven participants (men=21, women=16) with a physician’s diagnosis of PN were recruited from the Tyler metropolitan area. They were randomly assigned to either Tai Chi exercise (Ex, n=20) or control group (Con, n=17). All participants signed informed consents prior to testing. Exercise Program: Exercise consisted of 12-week progressive Tai Chi (i.e., Yang Style), offered 3 times per week, 60 minutes each time. A typical Tai Chi practice session was 60 minutes long, included diaphragmatic breathing and gentle stretching exercises for warm-up (10 min), learning and practicing Tai Chi. Assessments: One Repetition Maximum (1RM): One RM was conducted on weight machines (i.e., leg extension, and leg curl) muscle groups. Participants were asked to lift the weight one time as heavy they were able to lift within their comfort level. Time of 8 Foot up and Go (TUG): This test was used to assess agility, coordination and dynamic balance. The test requires standing up from a chair, walking eight feet, turning and walking back to the chair as quickly as possible. Six minute walk test (6MW): Participants were instructed to walk at their own pace trying to cover as much distance as possible in 6 minutes on an indoor track. To standardize the protocol, the participants were not coached during the test, but made aware of time remaining to completion. The distance covered was recorded to the nearest meter.

RESULTS
Participant Characteristics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Con (m17)</th>
<th>Ex (m20)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yr)</td>
<td>75 ± 9.02</td>
<td>71 ± 9.50</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>170 ± 12.04</td>
<td>173 ± 6.63</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>83 ± 20.15</td>
<td>87 ± 12.92</td>
</tr>
<tr>
<td>BMI (kg m²)</td>
<td>28 ± 5.69</td>
<td>29 ± 3.82</td>
</tr>
</tbody>
</table>

Table 1. Values are means ± SD.

Changes in lower muscle strength (pre and post)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Con (m17)</th>
<th>Ex (m20)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leg Extension (kg)</td>
<td>22.94 ± 17.46</td>
<td>23.91 ± 18.65</td>
</tr>
<tr>
<td>Leg Curl (kg)</td>
<td>31.55 ± 15.72</td>
<td>32.15 ± 15.68</td>
</tr>
<tr>
<td>TUG (sec)</td>
<td>11.10 ± 4.61</td>
<td>10.87 ± 4.51</td>
</tr>
<tr>
<td>6MW (m)</td>
<td>393.3 ± 141.7</td>
<td>398.6 ± 148.7</td>
</tr>
</tbody>
</table>

Table 2. Values are means ± SD. * p < 0.05 vs. Pre

CONCLUSIONS
These findings demonstrated that Tai Chi was capable of increasing lower extremity muscle strength and physical function among PN patients. Interestingly, Tai Chi training was able to increase the distance covered during the 6MW test, and to reduce the risk for loss of functional mobility (i.e., decreased 8-foot up-and-go time) among the participants.

ACKNOWLEDGEMENTS
We would like to thank Linda Friedemann, Scowmya Varghadda (graduate student research assistant), Crystal Bryco, Laura Hoyt, and Kleanthe Caruso for their technical assistance. This research was supported by The University of Texas at Tyler - College of Nursing & Health Sciences Intramural Grant Program (2015).