Original Article

Comparison Between Yoga Exercises Versus Tai Chi Exercises For Dynamic Balance Training Among Diabetic Neuropathy Patients

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Abstract

Diabetic Neuropathy is one of the most common complication known to adversely affect the vestibular system and exacerbate disbalance and therefore increase the risk of falling. The aim of the study is to compare the effectiveness of Yoga versus Tai Chi exercises to improve balance, gait disturbance and muscle weakness in patient of diabetic neuropathy. A total number of 60 subjects was randomly assigned to one of the two groups. The treatment program was followed for 8 weeks (3 times) each week and were assessed at 4th and 8th week. The two outcome measures of Berg Balance Scale and Sara Scale for assessing muscle weakness, dynamic balance and gait disturbances were assessed to measure effectiveness. The yoga interventions brought significant improvements across various outcome measures over the 8 weeks period of study (BBS, p =0.036**; SARA, p=0.016**).

Keywords: Diabetic neuropathy, Yoga, Tai Chi approach,Muscle weakness, Dynamic Balance, Gait disturbance, Berg balance scale, SARA

INTRODUCTION

Diabetes is one of the commonest ailments affecting almost 422 million people worldwide and expected to increase to 642 million by 2020(Lin et al., 2020). Among various complications, Diabetic neuropathy (DN) is the commonly prevalent peripheral nerve dysfunction. Studies have shown that Neuropathy is estimated to be present in 7.5% of patients at the time of diabetes diagnosis. Among them more than half of cases are distal symmetric polyneuropathy whereas 14 to 30% of the cases are focal syndromes such as carpal tunnel syndrome (14-30%) (Cho et al., 2018). According to recent study published in USA, it was observed that 47% of patients with diabetes have some peripheral neuropathy.

This has wide implications as diabetes stands out as an important health issue in the public discourse, adversely affecting the quality of life quite significantly. Literature evidence states that diabetic neuropathy causes loss of motor axons with insufficient re-innervation leads to deficit in muscular strength and thus lower limb muscle atrophy, while loss of sensory nerve function results in a decrease in sensory input sensitivity from the extremities. Proprioception and somatosensory input from the foot are important factors of motor control during balance and walking. Proprioception thresholds are higher in older patients with peripheral neuropathy due to somatosensory loss (Tandon et al., 2018).

A general strategy for balance training is suggested to be sensorimotor training as Movement problems result from any muscle imbalance in the postural control muscles, which ultimately alters the CNS's motor programming. Sensorimotor training first facilitate sensory inputs (proprioceptive and somatosensory structures), then correct muscular imbalance, and ultimately facilitate proper motor programming to address these deficits (Shah, 2016). Balance training as part of sensorimotor training has been demonstrated to enhance trunk proprioception in Diabetic neuropathy patients, in addition to improving balance and spatiotemporal gait parameters (Misha and Velmurugan, 2017).

There are different treatment options to address the balancing problems associated with diabetic neuropathy, according to research findings. Effective fall prevention techniques include moderate exercise, strength training, flexibility training, and balance training (Willis et al., 2017; Misha and Velmurugan, 2017 and Kobayashi and Zochodne, 2018). Strength training is widely suggested for such patients in order to increase muscle mass, strength, and ultimately attain independence in ADLs. Strength training can be done in a variety of ways depending on the physiological, functional, or performance goals (Salsabili, Forogh and Rajabali, 2011; Mueller et al., 2013; Sartor et al., 2014 and Holmes and Hastings; 2021)

Among other different novel techniques, tai chi and yoga exercises are other group of exercises which focusses on balance training and can regulate nerve activity in diabetic neuropathy patients(Li and Hondzinski,2012; Chao et al.,2018 and Kanjirathingal et al.,2021). However, there is a dearth of data demonstrating how such techniques can affect sensorimotor and gait training and thus can affect neuromuscular processes. Therefore, the present study aims to measure the effectiveness of tai chi versus yoga exercise in the management of diabetic neuropathy patients.

METHODOLOGY

A total number of 60 T2DM patients presenting symptoms of diabetic neuropathy were recruited from Department of Physiotherapy, Highland Hospital Research and Diagnostic center, Mangalore. The inclusion criteria for the patients who volunteered to participate in the study were clinically diagnosed with DPN, between 45 to 65 years of age with loss of protective sensation, a vibration perception threshold of 20 V in the foot, and a minimum score of 20/40 on the visual acuity test as well as . The exclusion criteria included diabetic patients having history of foot ulcer, recent neuromusculoskeletal injury, acute cardiovascular problems (within 3 months), patients using assistive device or participation in any type of intensive physical activity, including aerobics, resistance training etc. (Lee et al.,2015; Xia et al.,2019).

In order to determine the necessary sample, with a power of 0.80, a significance level of 95%, and an estimated dropout rate of 10%, a minimum of 56 experimental units in the 3 groups under study experimental units in the experimental group were needed, for a total of 56 experimental units, in order to achieve a statistically significant difference using the muscle strength score obtained as a dependent variable. After taking the necessary approval from the institutional review board, the shortlisted participants who consented to participate were randomly assigned to either of the three groups, namely Group A(n=20) who received Tai Chi yoga exercises, Group B[n=20] who received tai chi treatment while the third group was control group having received the conventional balance exercises. The duration of exercise was 60 minutes per session for 8 weeks [3 times per week]. All the subjects assessed with berg balance scale (BBS) and Sara scale. After giving treatment for 8 weeks, all subjects were reassessed (Yang et al., 2018)

A thorough verbal explanation of the process was given to the subjects and any queries on their part were answered before the study. Prior to the commencement of the study, complete evaluation was done and demographic data was collected which included subjects' weight, age etc. The yoga exercise protocol comprise of 8 types of yoga postures identified as (a) Vrikshasana(Single limb stance with support), (b) Tadasana (Bilateral heel rise with support (wide BOS), (c) Padhastasana (Bending forward to reach toes), (d) Virabhadrasana (Lunge forward and sideward with support), (e) Utkatasana (Partial squats with support), (f) Garudasana (Slightly bend knees, cross unsupported limb over stance limb with support, try to hook the feet behind calf), (g) Natrajasana (Single limb stance grasping unsupported limb at ankle) and Ardhachandrasanas (Bend forwards extend leg rotate trunk raise arm sideward with support) (Innes and Selfe,2016; Willis et al.,2017;Kanjirathingal et al.,2021)

The Tai Chi exercise protocol is a "hybrid" form of exercise that combines 12 motions from the Yang style Tai Chi (Chao etal, 2018). The exercise protocol blends stretching, breathing along with gentle, fluid, and subtle movements done with the knees bent in a modest semi-squat. Each session begins with specialized whole-body warm-up exercises (10 minutes),40 minutes of Tai Chi movements, and finally ends with cool-down activities (10 minutes) (Hung et al.,2009; Xia et al.,2019). The control group comprised of traditional balancing exercises were taken from earlier studies that aimed to test the somatosensory system. The outcome measures used to evaluate dynamic balance were robust clinical tools including Berg balance Scale (BBS) and SARA scale as a measure of gait status and ADL independence.

DATA ANALYSIS

Table 1 showed that there were no discernible differences between the groups. The scores of berg balance scale (BBS) and Sara scale (SS) interventions in the patients were compared using ANOVA. To compare pre, mild and post treatment scores in patients Kruskal Wallis test was used. Statistical significance was defined at $p<0.05$ for a two-sided (a=2) p value.

	Interventions		
	Yoga(20)	Tai Chi(20)	Control (20)
Variables			
Age	52±5.3	54±3.9	53±4.7
Gender	20	20	20
Female	10	10	10
Male	10	10	10
BMI (<25)	7	9	8
BMI (>25)	13	11	12

RESULT

Scores of berg balance scale(BBS) and scale of rating of assessment of Ataxia(SARA scale) were compared for pre,

mid(after 4 weeks) and final(after 8 weeks) of treatment in the Type II diabetes patients by using Kruskal Wallis Test followed by post hoc analysis(Dunn test). The level of significance (P-value), less than 0.05 was considered significant.

	Group	N	Mean	S.D.	P Value
Pre BBS	Group A	20	38.87	2.92	1.2
	Group B	20	39	2.81	
	Group C	20	38.14	2.53	
Mid BBS (After 4 wks)	Group A	20	45.77	2.26	Gp. A Vs Gp C (0.032**)
	Group B	20	42	2.91	Gp. B Vs C (0.379)
	Group C	20	41.86	2.74	Gp. A Vs. Gp. B(0.023**)
Post BBS (After 8 Wks)	Group A	20	51.49	2.10	Gp.A Vs Gp C (0.029**)
	Group B	20	45.53	1.72	Gp. B Vs C (0.732)
	Group C	20	44.71	2.31	Gp. A Vs. Gp. B(0.036**)

Table 1: Berg balance score in Group A and Group B in pre, mid and post

	Group	N	Mean	S.D.	P Value
Pre SARA	Group A	20	9.83	1.047	0.72
	Group B	20	9.27	1.10	
	Group C	20	9.51	1.34	
Mid SARA (After 4 wks)	Group A	20	5.67	1.113	Gp.A Vs Gp C (0.012**)
	Group B	20	7.27	0.88	Gp. B Vs C (0.471)
	Group C	20	7.43	1.21	Gp. A Vs. Gp. B(0.034**)
Post SARA (After 8 wks)	Group A	20	1.73	1.163	Gp.A Vs Gp C (0.029**)
	Group B	20	5.40	0.91	Gp. B Vs C (0.732)
	Group C	20	5.91	0.71	Gp. A Vs. Gp. B(0.016**)

Table 2: SARA score in Group A and Group B in pre, mid and post

The findings of the study revealed that following 8 weeks of intervention Yoga exercises was much effective in improving dynamic balance among the Type II diabetic patients as compared to the Tai Chi approach, found to be statistically significant ($p \leq 0.05$). The findings of the study also suggested that within group comparison among all the 3 treatment approaches were effective in improving dynamic balance as well as gait disturbances with reference to the pretreatment levels.

DISCUSSION

In contrast to traditional chinese yang type tai chi exercises, the 8 weeks, the ancient indian Yogic intervention exercises showed better improvement in measures assessing clinical static and dynamic balance among diabetic neuropathy patients.

The yoga exercises comprised of a variety of exercises, performed in various postures (Innes and Selfe, 2016). Some of the exercises performed namely, Vrikshasana, Garudasana, Virabhadrasana, Natrajasana, and Ardhachandrasana were in fact single-limb poses with the head-trunk-arm component supported by a modest base of support over one foot to preserve standing balance. It was observed that these poses demanded sound postural stability. For instance, performance of the exercise Vrikshasana (Single limb stance with support), one has to extend his/her arms out to the sides while maintaining an upright posture (Kanjirathingal et al., 2021). This probably might be an effective exercise to test one's postural control.

Similarly, while maintaining the same stance, other popular yoga exercises such as Natrajasana (Single limb stance grasping unsupported limb at ankle) and Ardhachandrasanas (Bend forwards extend leg rotate trunk raise arm sideward with support) pose COM outside the little base of support. The exercises involved stepping out of the general BOS as well as encouraged changes in weight distribution, which are thought to encourage body awareness as well as improving postural control. Likewise, another yogic exercise component, Tadasana, might improve postural control through pelvic stabilization. While putting entire body weight on one's toes, the exercise encourages equal weight distribution through the coactivation of hip flexors and extensors (Li and Hondzinski; 2012 and Kanjirathingal et al., 2021)

In terms of biomechanics, it is understood that body support on a single limb engages three key antigravity muscles of the lower extremity. These are the hip extensors, knee extensors, and ankle plantar flexors (Yu et al., 2021). Thus, while performing these three yogic exercises namely, Virabhadrasana, Natrajasana, and Ardhachandrasana it is required that the swinging extremity and the trunk should remain parallel to the floor. This facilitates flexibility by using the quadriceps, gluteal muscles, core muscles, and abductors of the opposite extremity to be used resulting in increase of muscles' strength. The present study's findings corroborated those of past research that showed yoga training could boost balancing abilities (Willis et al., 2017; Yang et al., 2018; Kanjirathingal et al., 2021). While prior research has shown that yoga exercises can enhance balance, the current study did find that doing so required a change in somatosensory inputs (surface

modification). Improvements in lower extremity strength seen in group 1 relative to the other two groups may be attributable to the use of these muscles during the yoga movements.

The improvements in group 1 might be because of the fact that the large muscles of the lower extremity were specifically targeted by different 8 yoga exercises performed over the two months period regularly. This would have improved postural control as well as decreased fear of fall after Yoga exercises being compared to Tai Chi and other control. It is anticipated that an increase in balancing confidence might have had created a good impact on function as well as active engagement in everyday activities. Nevertheless, measuring the impact of each Yoga intervention on individual static and dynamic performance were outside the purview of this study and thus could be considered as one of the limitations of the study.

On the other hand, Tai Chi, one of the popular Chinese therapeutic exercise program, are low to moderate intensity form of aerobic training exercise. Literature review emphasized on the fact that training methods, posture, frequency, and length were the key determinants of Tai Chi exercises. In addition to this, the multi-faceted yang style tai chi exercises incorporates behavioural, psychosocial, emotional, and spiritual components in addition to the use of oxygen, which might have been responsible for the desired benefits in the dynamic balance of the Type II diabetes patients over the 8 weeks period.

Tai Chi might have benefitted the diabetic patients by enhancing the motor nerve conduction velocity of the various nerves of the lower limbs, enhancing the distal sensory latency as well as vascular function thereby encompassing mind-body strategy which might improve the use of the active brain networks(Hung et al.,2009; Manor et al.,2019).

However, comparing them with the yoga exercises , the yogic interventions brought about greater benefits to dynamic balance , found to be statistically significant across various balancing parameters(BBS, p =0.036**; SARA , p=0.016**, Table 1 and 2).

RELEVANCE TO CLINICAL PRACTICE & LIMITATIONS:

This study will help in giving some concrete information about the effectiveness of yoga exercises over tai chi and other conventional exercises resulting in significant improvement in balance, muscle weakness and gait disturbance of diabetic neuropathy patients based on BBS and SARA outcome measures. However, there was some limitation too. The duration of the study was for two months and therefore the long lasting effects of the various exercise intervention over such patients could not be studied. The future researches can be done using more standardized quantitative tools to evaluate their therapeutic value.

CONCLUSION:

The present study has shown that yoga exercises are more effective in alleviating balance impairment as compared to tai chi exercise training. The research provides evidence to claim that the novel treatment methods can be used judicially for improvement of dynamic balance among diabetic neuropathy patients.

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