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Case Study

EFFECTS OF YOGA-BASED EXERCISES ON BALANCE IN CHRONIC POST-STROKE PATIENTS

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ABSTRACT

Background and Purpose: This was a preliminary investigation of the effects of a yoga-based exercise program on people with chronic (> 9 months) poststroke hemiparesis on balance. Most of them report an impaired health status because of a reduced level of activity. Proponents of yoga contend that it offers a gentle alternative exercise program that can be easily adapted for people with post stroke hemi-paresis to improve balance

Subjects and Methods: Four subjects with chronic poststroke hemiparesis participated in this study. The primary outcome measures were the Berg Balance Scale (BBS), Timed Up and go test (TUG) and Tinetti's POMA(Performance oriented mobility assessment). The 4 week intervention phase consisted of 40 min yoga sessions, 3 times per week, in the subject's home. The primary outcome data were collected pre and post intervention.

Results: All Subjects had improved BBS & POMA scores, and reduced TUG scores post intervention

Discussion and Conclusion: The results suggest that yoga may be beneficial to post stroke hemiparetic patients. Further investigation is required to further examine the effects of yoga in this population.

KEY WORDS: Hemiparesis, Yoga, BBS, POMA, TUG.

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INTRODUCTION

Stroke is the leading cause of adult disability associated with increased risk of falls [1]. Stroke is one of the leading causes of death and disability in India. The estimated adjusted prevalence rate of stroke range, 84-262/100,000 in rural and 334-424/100,000 in urban areas. Decreased range of motion and muscle weakness have been observed in people following a stroke. The majority of people who have had strokes have mild to moderate neurologic deficits [2]. Even the fittest people who have had a stroke tend to have an impaired health status compared with age-matched control subjects falls being the most important risk factor. Forster and Young reported that 73% of elderly people who have had strokes fell within 6 months after discharge from the hospital [3-5]. With the rising number of people surviving strokes today, there is a vital need for exercise programs designed to improve and maintain the physical fitness and quality of life of this population. Several investigators, however, have found that improvements in muscle force, balance, aerobic capacity, and timed mobility in subjects with chronic poststroke hemiparesis can be achieved with exercise training [5,8]. Potempa et al and Macko et al reported improved aerobic capacity in people greater than 6 months poststroke, following exercise with a bicycle ergometer or

after treadmill training [5]. In subjects whose stroke occurred more than 1 year prior, Weiss et al demonstrated improvements in muscle force, balance, and timed mobility after performing 12 weeks of a lower-extremity progressive resisted exercise training program at 70% of one repetition maximum [6]. Yoga is one of India's oldest and most extensive psycho-spiritual traditions [8,13]. The word "yoga" is derived from the Sanskrit verb "yuj" meaning to yoke or unite. Commonly, yoga is translated to imply the union of body, mind, and spirit [13]. Yoga is translated to imply the union of body, mind, and spirit. There are 8 main forms of yoga. Many forms of yoga encompass 8 elements, known as the "eight-fold path" of yoga, which include yamas (moral disciplines), niyamas (self-restraint), pranayama (breath control),asanas (physical poses),pratyahara (sensory inhibition), dharana (concentration),dhyana (meditation),and samadhi (blissful state) [13]. Yoga therapeutics is defined by International Association of Yoga Therapists as the application of yoga for health benefits [15]. It uses body awareness and breathing activities, physical postures, and meditation with an understanding of pathological conditions. Yoga therapy offers an alternative approach to conventional exercise training, and it also can be adapted to meet the needs of people with physical limitations [15].

A regular practice of yoga has been shown to improve flexibility and muscle force in adults without known Pathology [14]. Although there have been limited studies that have investigated the effects of yoga on people who have had a stroke or hemiparesis, Bell and Seyfer have described adaptations of yoga postures that can be applied to people with neurologic conditions such as multiple sclerosis and stroke[16]. Proponents of yoga believe it offers a holistic approach to rehabilitation, which includes eliciting relaxation through meditation [10]. Musculoskeletal problems may greatly influence postural stability and control [12]. Decreased range of motion and muscle weakness have been observed in people following a stroke [3]. Studies of varied outcomes have revealed that voluntary muscle force is closely correlated to gait performance in people following a stroke [7], and it may contribute to the balance and mobility prob lems of these people [7,8]. We were interested in knowing whether yoga therapy might be useful for people who have had a stroke. The purpose of this study, therefore, was to investigate the effects of a yoga-based exercise program on balance, mobility, and quality of life for people with chronic poststroke hemiparesis.

SUBJECTS AND METHODS

Subjects: A single-subject study design was used with each of the 4 subjects who participated in this study. The subjects were recruited from the community surrounding talegaon dabhade, pune, maharshtra india People were considered for participation in the study if: (1) more than 9 months had elapsed since their stroke; (2) they were moderately impaired in lower-extremity motor function (a lower-extremity motor score between 15/34 and 27/34 on the Fugl-Meyer Sensorimotor Assessment[20] (3) they were able to ambulate independently with or without an assistive device and (4) they had completed all rehabilitation. Subjects were excluded if they had: (1) a medical condition that interfered with participation in exercise programs, (2) a score of less than 15/30 on the Mini-Mental Status Examination[20], or (3) receptive aphasia that interfered with the ability to follow 2-step commands.

Subject 1: Subject 1 was 70 year-old lady who had a left cerebrovascular accident (CVA) 3 years before the start of our study, which caused right hemiplegia. She had history of hypertension, diabetes mellitus, and pacemaker .Immediately following her stroke she spent several weeks in acute care and inpatient rehabilitation facilities. She was discharged to her home and completed her rehabilitation in an outpatient setting.Two months later she shifted to Talegaon from Mumbai in a chapel in mount saint Anne's school. She was active in school and church programs. She could ambulate independently without the use of assistive device within the chapel; however, she used a railing when going up and down stairs and a cane when ambulating outside the chapel. She reported that she occasionally stumbled and lost her balance. She had history of fall once in past one year. She was independent in all self-care activities

except bathing and dressing upper segment. Before the initiation of this study, subject1 had received physical therapy for 2 years.

Subject 2: Subject 2 was a 50-year-old man who had a left CVA with subsequent right hemiparesis, nonfluent expressive aphasia, 10 years before our study began. He had a history of hypertension before his stroke. After his stroke, he spent 1 year in the state of coma, followed by several weeks in an inpatient rehabilitation setting. He was discharged to his home and received several weeks of outpatient rehabilitation. He reported no other medical conditions. He resided in an urban environment in a home with his wife, 1 young adult daughter, and 1 teenaged son. He had taken voluntary retirement from his job. He reported loss of balance and occasionally stumbled while walking on uneven terrain. He had not fallen since being discharged from rehabilitation. He could perform all basic self-care activities independently.

He had completed his rehabilitation in physical therapy or occupational therapy more than 5 year before the start of our study. He performed a home exercise program that included standing balance and right lower-extremity weight-bearing activities and walked approximately 4km every day. He walked independently in household and community without any devices.

Subject 3: Subject 3 was a 65-year-old man who had a right CVA resulting in left hemiparesis 3 years before the start of our study .He had focal lacunar infarct in right lentiform nucleus and the right periventricular white matter. His medical history include hypertension for which he is on regular medications. Following the right CVA, he spent several weeks in an acute care facility and then had inpatient rehabilitation. He was discharged to his home where he resided with his wife and 1 adult unmarried son. He received home health services, including those from a nurse, a home health aide, a physical therapist. He was discharged from outpatient physical therapy approximately 1year before the start of our study. He required minimal assistance for climbing up to 14 steps and used one railing. He required assistance for upper-extremity dressing and for showering, but he was independent in all other basic self-care activities. He said he had a fear of falling, but had not fallen since stroke. He reported that he walks independently in household and community without any devices.

Subject 4: Subject 4 was a 51-year-old man who had a right CVA 1 year before the start of our study, which resulted in left hemiparesis. Following his stroke, he spent several weeks in acute care and inpatient rehabilitation before being discharged to his home. He was independent in self-care activities and mobility. Before his stroke, he had been employed as an assembly-line worker. He had taken voluntary retirement from his job.He lived in an urban single-story home with his wife and two young sons. He was independent in all basic self-care activities. He said he felt unsteady while walking on uneven terrain and walked slowly. He had fallen twice from steps in the year before our study without sustaining a serious injury. He had received physical therapy for 5 months. He said he has a routine exercise program, and he did take leisure walks every alternate day in a week for approximately 1km.

Procedure: An interview and examination were conducted with each subject. Demographic and descriptive information was obtained. The primary outcome variables were balance (Berg Balance Scale [BBS][20] and timed mobility (Timed Up and Go test) and POMA(Performance based mobility assessment) [20]These variables were selected to reflect areas of known difficulty in this population.

Methodology: A 4 week program included

Table 1: Showing the 4 weeks scheduled exercises.

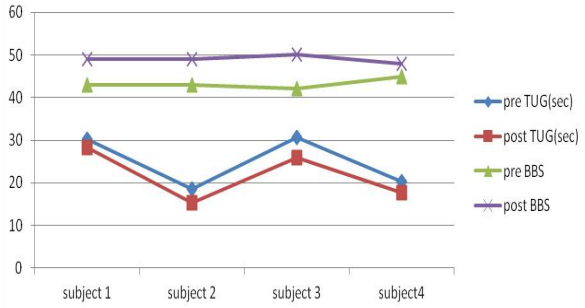
Warm up exercises Sitting	Warm up exercises Standing	Standing asanas With chair as support	Aasanas in supine
Ankle stretches Ankle circles Knee ROM exercises Hip flexion exercises Shoulder circles Neck flexion/extension	Spot marching Trunk flexion/ extension	Tadasana Uttanasana Modified uttkatasana Uthitasana Warrior pose I Warrior pose II Vajrasana Ushtrasana [13,14,17,11]	Setubandhasana Shavasana(used as cool)down execise

RESULTS

Berg Balance Scale Visual analysis of the BBS data revealed some variability in baseline scores for all subjects, it showed more than 6 score increase. Stevenson[5] has reported that a change

of 6 points on the BBS is necessary to be 90% confident that a clinically meaningful change has occurred in people who have had a stroke. We documented a change mainly in items like Standing unsupported with feet together, Reaching forward with out-stretched arm while standing, Pick up object from floor, Turning to look behind, Turn 360*,Place alternate foot on stool ,Standing unsupported one foot front, Standing on one leg in BBS. Timed up & go test showed reduction in score in all four patients. Average time taken by the 4 subjects pre treatment was 24.99 sec (SD- 6.39sec) Average time taken by the 4 subjects post treatment was 21.88sec (SD-6.30sec) The over-all time reduced after the treatment was 3.16s +/- 1.13s.The average difference reduced was not statistically significant. (z=0.01, p <0.05) POMA showed changes in items of Gait including Step length and cadence.

Fig. 1: Showing the pre and post TUG and BBS.



All subjects in our study demonstrated some positive effect in the primary and secondary outcome variables. Not all of the subjects had similar responses to the yoga intervention, and there were several differences among the subjects that may have contributed to the variance in the results. The study reveals that following items showed a remarkable improvement; Standing unsupported with feet together(BBS item no7, POMA item no 6) - Tadasana, Uttanasana Reaching forward with out-stretched arm while standing.(BBS item no 8) -Modified Utkatasana Pick up object from floor(BBS item no 9)- Uttanasana Turning to look behind(BBS item no 10)- Ushtrasana, Virabhadrasana 1Turn 360*(BBS item no 11, POMA item no 8) Place alternate foot on stool (BBS item no 12)-Virabhadrasana 1 and Virabhadrasana 2 Standing unsupported one foot front (BBS item no 13)- Virabhadrasana 1 and Virabhadrasana 2 Standing on one leg (BBS item no 14)-Virabhadrasana 1 and Virabhadrasana 2.

This could be attributed to Increase in strength in antigravity muscles especially hip extensors and ankle plantarflexors [11]; Asana strengthens the postural muscles, mainly in Tadasana, Virabhadrasana 1, Virabhadrasana 2, Uttanasana through postural mechanism facilitation (eccentric contraction in close kinematic chain pattern).Taylor M et al did a similar study in parkinsons patients and found out that yoga increases the strength in functional postures and also adds to the endurance of the anti gravity muscles which are the main stay in maintaining postures [8]. Endurance is the capacity of the muscle to contract continuously at submaximal level also improves through relaxation [4]. Concentration throughout the process with breath regulation causes reciprocal relaxation of muscles after release of the asana. Wallace et al studied the physiological effects of meditation which is imparted with the controlled breathing techniques in yoga to confirm that meditation brings about an overall calmness and clears the mind of stress which makes it possible to take better decisions which in turn plays an important role in risk taking ability [10].

Increase in elasticity of muscles: Uttanasana is the asana which works on the principle of elastic behavior of material helps in increasing the elasticity of spinal musculature, hamstrings and tendo Achillis. Increase in range of motion and spinal flexibility [6,7]: Asana facilitates the accessory movements of glide and roll of the joints for effective full range of angular motion of joints, mainly in Uttanasana, Modified Uttkatasana, Virabhadrasana 1, Virabhadrasana 2, Ushtrasana, Setubandhasa [18].

Rhythmic stabilization: this is achieved by the setubandhasana asana and also it strengthens spinal musculature.Stretching of muscles: stretching of all antigravity muscles, mainly Tendo achillis, Hamstrings, Back extensors and Thoraco- dorsal fascia is achieved by Uttanasana, Virabhadrasana1 and Virabhadrasana2.Risk taking ability may be increased due to repeatedly performing the Asana. Increased level of confidence as reported by the subject [14-16].

Yoga therapy practitioners believe that acknowledgment and empathetic support given while a person expresses emotional and spiritual

feelings may greatly facilitate healing of the person's body, mind, and spirit daily participation in some of the yoga activities enhanced her attention and concentration and decreased her physical impairments enough to affect her postural stability and control while performing the BBS tasks. It would have been interesting to determine whether changes in her perception of overall physical functioning and measures of mobility would have improved with a longer duration of the yoga intervention [19].

Overall, our results suggest that yoga may be beneficial for people with chronic poststroke hemiparesis, but further investigation is warranted. Our data suggest that the BBS may not be sensitive to detect changes that may occur in some people with high-level balance deficits, a finding previously reported by other authors Our recommendation for future investigations is to include additional impairment measures to clarify the relationship between changes in impairments and changes in speed of performing movement tasks to be able to determine the effects of yoga on flexibility, muscle force, endurance, and motor function in people with chronic poststroke hemiparesis.

CONCLUSION

This preliminary investigation of the effects of yogic exercise program lends support to the growing evidence that improvements in impairments and mobility limitations can be achieved with people with chronic poststroke hemiparesis with yogic exercises.

The differences in the outcomes demonstrated by the subjects in our study may be explained by the differing characteristics of each subject.

Future studies with larger samples and control subjects are needed to offer more conclusive evidence of the benefits of a yoga-based exercise program on balance and mobility for this population.

Conflicts of interest: None

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