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Original Research Article

Impact of Selected Yoga Practices on Balance and Flexibility among Geriatric Population

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Abstract

Purpose of the Research: The determination of the present research was to find out the influence of yoga exercise on balance and flexibility among male geriatric population. ***Materials and Methods****:* 30 elderly men who lived in the Anbagam Old Age Home, Mariappanagar, Annamalainagar Town, Chidambaram City, Tamilnadu were selected as subjects. The oldness of the subjects was ranged between 60 and 65 years. They were divided into two groups equally, apiece group consisted of fifteen subjects, in which experimental group - I underwent selected yoga practice, and group - II represented as control that did not participate in any rehabilitation proramme apart from their routine living activities. The experimental period for the study was 6 days (Monday to Saturday) per-week week for twelve weeks. Prior and after experimental period; the volunteers were tested on balance and flexibility. Balance was measured by 4 stage balance test and flexibility was assessed by sit and reach test. ***Statistical Techniques Applied****:* The examination of 't' – test and assumption of equality of variance (Leven's test-homogeneity) and analysis of covariance (ANCOVA) was utilized to discover the critical contrast, assuming any, between groups on each selected variable, independently. In all the cases, 0.05 degree of certainty was fixed to test the importance, which was considered as proper. ***Results:*** The result of the study shows that the selected yoga practice has improve the balance and flexibility significantly. ***Conclusions:*** It was concluded from the consequences of the study that experimental group has bring positive changes in balance and flexibility as compare to the control group.

Keywords: Yoga practice, geriatric, balance, flexibility and ANCOVA.

INTRODUCTION

In the United States, those over 65 made up 4% of the population in 1900; now, that number is over 14% (almost 50 million, with a daily net addition of 10,000).[Richard, (2021)] Geriatricians plan, coordinate, and prevent medical interventions that are specific to the needs of the aged people [Retrieved from file:///E:/all%20new/scr/malini/What%20is%20Geriatrics_.html on 23-02-2021]. It has been assessed that the population with adult congenital heart disease (ADHD) increases by 5% every year [Hoffman, 1990; Brickner, Hillis and Lange, 2000; Perloff and Warnes, 2001; Niwa, 2004]; hence, there would have been an additional 4,00,000 increase in this populace between 2000 and 2012.

India, the second most populous country in the world, has had a dramatic shift in the last fifty years in the population segment, almost entirely due to an increase in the number of people over sixty (elderly) [Government of India, 2011]. According to projections, the percentage of Indians who are 60 years of age or older will increase from 7.5% in 2010 to 11.1% in 2025 [United Nations, 2008]. India's elderly population is expected to reach 158.7 million by 2025 [United Nations, 2008] and will typically surpass the number of children under 14 by 2050 [Raju, 2006].

The term "geriatrics" refers to clinical care for aged adults, a demographic that is relatively easy to explain. The term "older" is preferred over "aged," although both are equally ambiguous; although > 65 is the often-used age, many people don't need to take geriatrics seriously until they are 70, 75, or even 80 years old. The experiment of ageing, encompassing changes in biology, society, and psychology, is known as gerontology. Longitudinal processes associated with

physiological changes that occur with ageing include elevated stress, dysfunctional mitochondria, aberrant inflammatory processes, reduced hormone production, and slowed metabolism, which can result in organ degeneration and catabolism [Cesari *et al*., 2013; Sieber, 2017].

The bodily and psychological health of older persons may alter. As people age, their physical capacity reserve often decreases, which has an impact on stability, gait speed, muscular strength, and balance control [Bird, *et al*., 2009; De Carvalho, *et al*., 2017; Emilio, *et al*., 2014; Yang, *et al*., (2018)]. Many of the systems deteriorate throughout this age. This might negatively impact quality of life, impair balance, limit safe mobility, and raise the risk of falling [Berg K. 1989].

Exercise and physical activity have many beneficial effects on maintaining wellness, preventing age-related chronic diseases, and enhancing the quality of life for senior citizens [Nelson, *et al*., 2007; Cornelissen, 2009; Heckman & McKelvie, 2008]. The area of medicine known as geriatrics focuses on the unique need's humans have as they age. Just as paediatricians are very authoritative when it comes to children's health issues, geriatricians are somewhat knowledgeable about the health needs of older people. Anxiety and dread around the decline in balance control and ensuing loss of independence are prevalent issues among the elderly [Dellinger, 2017].

Given that ageing causes a reduction in flexibility, which can make it more difficult to accomplish many everyday chores, it's critical to understand how various tactics might help older people maintain or increase their maximum range of motion. As people age, their joint flexibility may diminish [Roach and Miles, 1991; Nonaka, *et al*., 2002; Shields, *et al*., 2010], which might have an impact on their ability to go about their everyday lives normally. Age-related changes in spatiotemporal characteristics (i.e., walking speed, stride length, frequency of gait, and range of motion) and postural imbalances can both contribute to and result from a lack of flexibility in older adults. These make everyday tasks more difficult and, as a result, lower quality of life [Cristopoliski, *et al*., 2005; Weppler and Magnusson, 2010]. Reductions in range of motion (ROM) have also been linked to an increased risk of falls in middle-aged and older people [Heath, 2005].

Flexibility of the lower body is necessary for activities involving bending and reaching, whereas flexibility of the upper body is recognised to be vital for tasks like dressing and reaching for things [Spiriduso, Francis & MacRae, 2005]. The primary causes of the decline in flexibility and, consequently, the physiological changes associated with ageing are tight hamstrings, low stretch tolerance, poor hip contracture, altered pelvic tilt, and muscle-tendon stiffness [Youdas, *et al*., 2005]. Specifically, the neuromuscular system [Wu, *et al*., 2020] induces these modifications, which include endogenous alterations (i.e., changes in the sensitivity of peripheral nociceptors) [Støve, Hirata & Palsson, 2021] and decreased collagen synthesis in various tissues (i.e., skin, ligaments, tendons, and deep tissues) [Holland, *et al*., 2002; Frankel, Bean & Frontera, 2006].

Due to its inherent instability, walking on two legs takes constant management to maintain an upright posture. For babies, learning to do so is a significant developmental milestone. On the other end of the age range, it is commonly recognised that older persons have a higher chance of falling and that falls will almost certainly cause injuries [Herdman, 1997; Kannus *et al.*, 1999].

The vestibular system, which is located inside the inner ear and is where humans feel balance, is the cause of the falls. This system is linked to the brain, which signals the aged people when they are about to trip and falls and instructs the body to adjust. However, the vestibular system's cells die off, which impairs the capacity to adjust the posture. b. Age-related changes in vision impact contrast sensitivity and depth perception. This shows up as distortion and poor night vision. As the people age, their reflexes and coordination weaken. b. As the people age, their reflexes and coordination weaken.

Seniors' loss of postural control is recognised to be strongly correlated with the biomechanical limitations brought on by aging [Horak, 2006]. More precisely, the capacity to produce muscular strength and power is diminished in the aged, and this deficit seems to exacerbate postural instability and the propensity for falls [Bean, *et al*., 2007; Puthoff & Nielsen, 2007].

Yoga is a mind-body exercise that improves both mental and physical well-being [Kwok, *et al*., 2017]. Yoga poses that combine weight support and stretching assist elderly persons improve their range of motion in their joints and restore their flexibility [Grabara & Szopa, 2015]. Research indicates that yoga can help avoid infirmity in older persons by enhancing their functional capacities and flexibility [Bucht & Donath, 2019; Cicek, *et al*., 2015; Östh, *et al*., 2019; World Health Organisation, 2019]. Other low-intensity activities, including Tai Chi, were shown to have less of an impact on flexibility, strength, and balance than yoga [Gothe and McAuley, (2016); Ni *et al*., (2014); Noradechanunt *et al*., (2017); Saravanakumar *et al*., 2014]. Additionally, yoga's breathing techniques and mindfulness exercises can aid to enhance psychological consequences, such as stress, anxiety, and depressive symptoms [Bonura & Tenenbaum, 2014; Gothe, 2013; Gothe & McAuley, 2016; Noradechanunt, *et al*., 2017; Schmid, Van Puymbroeck & Koceja, 2010; Yao and Tseng, 2019]. Accordingly, it is seen to be a potential means of maintaining mental and physical abilities for ageing in a healthful manner [Sivaramakrishnan, *et al*., 2019].

Because yoga incorporates active mind-body involvement, it is believed to be more beneficial than regular exercise as a supplemental therapy [Oken, *et al*., 2006]. Feuerstein (2000) states that the goal of yoga therapy is enlightenment via the promotion of health and self-awareness. The proven advantages of yoga treatment include enhanced muscle strength, flexibility, range of motion, vitality, relaxation, and well-being; reduced pain; better sleep; reduced stress; and control over physiological parameters [Oken, *et al*., 2004; Raub, 2002; Tran, *et al*., 2001; Vempati & Telles 2002 and Malathi, *et al*., 2000]. Yoga can enhance older persons' balance and address fall risk factors such as poor balance, diminished strength and flexibility, and restricted mobility [Schmid, Van Puymbroeck & Koceja, 2010].

METHODOLOGY

To achieve the purpose of the present study, 30 healthy geriatric men from Anbagam Old Age Home, Mariappanagar, Annamalainagar town, Cuddalore district, Tamilnadu were randomly selected as subjects. The age of the volunteers was ranged from 60 to 65 years (mean age = 63.4 ± 0.7 years). The institutional ethics committee of the Cuddalore District Medical College and Hospital, Annamalainagar, Chidambaram provided the ethical approval. Based on inclusion and exclusion criteria, thirty senior citizens were comprised in the research. Male subjects, eager to engage in the study, prepared to sign a written informed consent form, and functionally independent—that is, scoring 100 points on the Barthel Index—were the study's inclusion criteria.

The following conditions had to be faced in order to be excluded from the present research: a history of recent musculoskeletal issues; a serious cardiac or pulmonary condition that might need hospitalisation; neurological disorders; a mental illness; a serious visual impairment, such as cataracts; a self-report of uncontrollable diabetes and hypertension and vertigo.

The selected subjects were separated into two equivalent groups of fifteen subjects each. Group - I considered as experimental group who underwent yoga practices for 12 weeks, 6 days (Monday to Friday) per week on selected yoga exercises (Table – I) and the same were taught by yoga teachers from Center of Yoga Studies, Annamalai University, Annamalainagar, Chidambaram and group - II considered as control which are not undergo any training programme or physical activity (either strenuous or recreational) throughout the experimental period.

For 12 weeks, subjects in group – I had yoga treatment and after twelve weeks, the subjects in group - II were asked to report. Important tips and precautions were discussed for doing asanas, like: Eat a small snack an hour before yoga class; Clear the bladder and bowels; Wear loose, comfortable clothing; and Avoid jerky movements when performing asanas. They were also tutored to maintain a regular breathing pattern while holding the pose and they were also trained not to push the body to reach the final position. Every pose was advanced progressively, going from the supine to the sitting to the standing positions.

Selection of Asanas

The training variable is the yogasanas and it's been incalculable. Subsequently, the researcher talked with specialists in the field of yogasana and the chose asanas are introduced in the Table – I.

Table – I: Training Schedule for Yoga practice group

Weeks	Name of the Asanas (Maintaining Duration in minutes : Recovery)
1 – 4	Suryanamaskar (18 Min : 5 Min), Adho Mukha Svanasana (1 : 1), Trikonasana (1 : 1), Badhakonasana (1 : 1) **- All 2 repetitions**, Shavasana (2 min) (1 min recovery) : Pranayama – Anuloma Viloma (5 min) : (1 min recovery) : Meditation – Omkar. (10 min)
5 – 8	Suryanamaskar (18 Min : 5 Min), Bhujangasana (1 : 1), Tadasana (1 : 1), Adhu Mukha Svanasana (1 : 1) Bhalasana (30 sec : 30 sec), Marjarasana (30 sec : 30 sec) **- All 2 repetitions**, Shavasana (10 min) : Pranayama – Bhastrika (5 min) (1 min recovery) : Meditation – Omkar. (10 min),
9 – 12	Suryanamaskar (18 Min : 5 Min), Bhujangasana (1 : 1), Trikonasana (1 : 1), Tadasana (1 : 1), Bhalasana (30 sec : 30 sec), Marjarasana (30 sec : 30 sec) **- All 2 repetitions**, Shavasana (10 min) : Pranayama – Nadi Sudhi (5 min) : Meditation – Omkar. (10 min).

Test Description

Balance was tested by administrating the 4 – stage balance test. The 4 - stage balance test, a proven tool, to test people for fall risk. Based on the person's capacity to maintain four increasingly difficult poses, it is determined [National Centre of Nutrition and Aging 4 stage balance test. Available from:https://nutritionandaging.org/4-stage-balance-test/#wbounce-modal (last accessed 16.10.2020)] (evaluates static balance) [Phelan, *et al*., 2015]. Directions: Four standing postures are available, each of which is more difficult to maintain. 1. Place your feet shoulder-width apart. 2. Position one foot such that its instep touches the other foot's big toe. 3. The tandem position Step forward with a foot that touches the toes with the heel. 4. Take a single step. [CDC 4 stage balance test [Available from https://www.cdc.gov/steadi/pdf/4-Stage_Balance_Test-print.pdf. (Last accessed on 16.10.2020)].

Flexibility was tested by conducting the chair sit and reach test. The geriatrician has to be seated on a

chair's edge that is safely pressed up against a wall. The subject can only have one foot flat on the ground. The second leg is stretched forward, ankle bent at a ninety-degree angle, heel on the floor, and knee straight. With the tips of the subject's middle fingers touching, place one hand on top of the other. The subject should instructed to inhale, and then to bend at the hips and extend forward towards their toes as the subject exhale. Maintain an upright back and a raised head. Never bounce or move quickly, and never stretch till it hurts. Hold the reach for two seconds while maintaining a straight knee. The measurement is taken from the tips of the fingertips to the toes. The score is 0 if the fingertips contacts the toes. Measure the distance between their fingers and toes (a negative score) if they do not contact them, and the amount of overlap (a good score) if the subject does.

Analysis of the Data

The data were collected on selected criterion variables such as balance was 4 stage balance test and flexibility was assessed by sit and reach test. To find the crucial difference, if any, between groups on each selected basis factor individually, the 't' test, assumption of equality of variance (Leven's test-homogeneity), and covariance (ANCOVA) were examined. In all the cases, 0.05 degree of certainty was fixed to test the importance, which was considered as proper.

Table – II present pre and post test means and the results of the paired sample t – test of yoga practice group and control group on selected dependent variables such as, balance and flexibility.

Table – II: Paired sample 't'- test of yoga practice group and control group on selected dependent variables

Name of the Group	Name of the Dependent Variable	Pre-test Mean	Post-test Mean	't' - ratio
Yoga Practice Group	Balance	41.26	49.41	43.59*
	Flexibility	-3.16	-1.10	35.88*
Control Group	Balance	41.81	41.35	0.86
	Flexibility	-3.26	-3.18	0.73

* Significant at 0.05 level of confidence. (Required table value for significance at 0.05 level of confidence with df 28 was 1.701).

Yoga Practice Group

Testing of Hypotheses – 1

The paired sample 't' was computed on selected dependent variables. The results were presented in the above Table – II. The 't' value for balance and flexibility were 43.59 and 35.88 respectively. All the 't' values are significantly higher than the required table value of 28 at 0.05 level of confidence was 1.701.

Researcher's hypothesis (H_1)	There would be a significant improvement in the selected dependent variables due to yoga practice.	**Accepted**
Null hypothesis (H_0)	There would be a significant improvement in the selected dependent variables due to yoga practice.	**Rejected**

Based on the study's findings, the 12-week yoga practice improved performance in all specified dependent variables, including flexibility and balance. Hence, researcher's hypothesis was accepted and the null hypothesis was rejected.

Control Group

Testing of Hypotheses – 2

The paired sample 't' was computed on selected dependent variables. The results were presented in the above Table – III. The 't' value for, balance and flexibility were 0.86 and 0.73 respectively. All the 't' values are significantly lower than the required table value of 28 at 0.05 level of confidence was 1.701.

Researcher's hypothesis (H_1)	There would not be a significant improvement in the selected dependent variables among control group.	**Accepted**
Null hypothesis (H_0)	There would not be a significant improvement in the selected dependent variables among control group	**Rejected**

The study's findings demonstrate that none of the chosen dependent variables, such as flexibility and balance, considerably improved the control group's performance. Hence, researcher's hypothesis was accepted and the null hypothesis was rejected.

Assumptions for ANCOVA

A preliminary analysis was conducted to determine whether the prerequisite assumptions of ANCOVA were met before preceding the Univariate Analysis. Thus, the assumption of equality of variance (Leven's test-homogeneity) the linear regression relationship between the covariates and the dependent

variables and homogeneity of regression slopes was examined.

Table – III: Levene's test of equality of error variances on selected criterion variables among groups

Variables	F – Ratio	df -1	df -2	Sig.
Balance	0.77	1	28	0.279
Flexibility	0.86	1	28	0.426

(The Table value required for 0.05 level of significance with df 1 & 28 is 4.20).

A word used to describe the comparable variations among groups is homogeneity of variances. The resultant F-values of the chosen dependent variables in Levene's test of equality of the error variance table, thus, were less than the confidence interval value of 0.05, indicating that the variance of each group was not statistically different from the other during the pre-test period. Thus, at the significant 0.05 level of confidence, homogeneity of variance for all three dependent variables has been fulfilled when comparing the two groups, independent of the ability level for each of the dependent variables. Thus, it was determined that in order to compute Univariate ANCOVA, the homogeneity of variance condition had been satisfied.

Table – IV: Analysis of covariance (ANCOVA) on balance and flexibility of yoga practice group and control group

Variable name		Yoga practice group	Control group	'F' - ratio
Balance (Seconds)	**Pre-test Mean ± S.D**	41.26 ± 1.86	41.81 ± 1.39	0.012
	Post-test Mean ± S.D.	49.41± 1.03	41.35 ± 1.20	113.86*
	Adj. Post-test Mean	48.864	41.556	185.55*
Flexibility (Inches)	**Pre-test Mean ± S.D**	-3.16 ± 0.046	-3.26 ± 0.051	0.886
	Post-test Mean ± S.D.	-1.10 ± 0.0036	-3.18 ± 0.011	158.91*
	Adj. Post-test Mean	-1.331	-3.116	189.43*

*Significant at 0.05 level of confidence. (The table values required for significance at 0.05 level of confidence for 1 and 28 & 1 and 27 are 4.20 and 4.21 respectively).

RESULTS OF THE STUDY

Table – IV shows that pre test means 'f' - ratio of yoga practice group and control group on balance was 0.012 which is insignificant at 0.05 level of confidence. The post and adjusted post test means 'f' - ratio value of experimental group and control group was 113.86 and 185.55, which was significant at 0.05 level of confidence. The pre test means 'f - ratio of yoga practice group and control group on flexibility was 0.886, which was insignificant at 0.05 level of confidence. The post and adjusted post-test mean 'f' - ratio value of experimental group and control group was 158.91 and 189.43, which was significant at 0.05 level of confidence.

CONCLUSION

This study sheds light on the perceptions of yoga among older people before to, and following intervention. Prior to participating in the treatments, it was seen that older adults had a variety of demotivating variables for yoga. These were mostly caused by a lack of knowledge and an inappropriate setting, time, location, and yoga/light exercise trainer coaching. Following this intervention, nearly every subject understood the benefits of yoga in controlling their sedentary life-style. Because they were more health-literate and received appropriate assistance without having to pay for it. It became clear that they could be done even at an older age, yoga and mild exercise were seen as suitable pastimes for senior citizens.

From our research, the yoga aids lower the incidence of fall-related cases, it is therefore possible to propose frequent yoga-based workouts for seniors 65 and older. According to some study's findings, seniors 65 years of age and more can benefit greatly from yoga-based therapies, which can help them gain postural control in a reasonable amount of time. Increases in muscle strength, endurance, flexibility, range of motion, and cardiovascular endurance have all been linked to yoga practice and its primary focus is on enhancing body awareness and proprioception, which will help older adults' balance. Yoga standing positions like tree pose (vrksasana), which include using the hip abductors and/or adductors, mimic the biomechanical demands needed to perform the OLS correctly. It is therefore possible to speculate that balance might improve as a result of practicing positions that test static equilibrium [Wang, et al., 2013]. The relevance of basic yoga movements is highlighted by the notable gains in both static and dynamic balance, along with considerable improvements in body integration, including reductions in fat and increases in muscle mass. These changes may make yoga a safe physical activity for those over 65. [Krejči, et al., 2022].

As to Jayasinghe, (2004), practicing yoga can enhance one's flexibility, balance, strength, and general fitness and the pranayam aspect of yoga, which involves deep breathing, can also improve cardiovascular rhythms, which in turn can increase heart rate variability.

After four weeks, it is concluded that yoga poses are useful in helping older people's balance when compared to the control group. As a result, it may be applied clinically to help older people with their balance [Patel, Deshmukh & Palekar, 2019]. Nick, et al., (2016) found that yoga can reduce fear of falling and enhance balance, two characteristics linked to fall risk in older persons and can also target established fall risk factors in older adults that can be included into fall prevention programmes. A 12-week yoga intervention was tested for its impact on fear of fall and balance in older persons by Schmid, Van Puymbroeck & Koceja, 2010 and the results showed that yoga improved static balance by 4% and reduced FOF by 6%. The study's FOF change showed a favourable trend, however it was not statistically significant.

Most of the research studies have reported that the yoga intervention with or without light exercise are effectively improve the flexibility, strength, pain management and betterment in sleep [Nayak, et al., 2015; Vogler, et al., 2011; Tiedemann, et al., 2013; and Youkhana, et al., 2016]. Sivaramakrishnan, et al., 2009; Nick, et al., 2016; Mooventhan & Nivethitha, 2017 declared that the flexibility increased after the yogic practice group when compared with the control group. After a 12-week period of Chen et al's., (2018) Silver yoga intervention among community-dwelling individuals shown a substantial increase in range of motion in the shoulder and hip, flexibility, hand grip strength, and walking speed. Our research's participants reported greater strength and flexibility, better sleep, more energy, relief from joint problems, exhaustion, and social behaviour as advantages of yoga and mild exercise following intervention. These findings are consistent with a similar study conducted in India [Sengupta, 2012].

DISCUSSION

This study investigates the viability of performing yoga, as well as how it affects older people's sedentary lifestyles. It was observed that regular yoga practice had improved their mental and physical health and well-being. Yoga training is a low-cost, easy-to-follow workout regimen that enhances well-being and functional fitness. From this study, we concluded that yoga is a better intervention tool to improve the balance and reduced the risk of fall on the floor risk and it also improves the mobility of geriatric population, which also helps to maintain the balance.

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