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The Improvement of Equilibrium through Yoga Exercises

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A B S T R A C T

Yoga, one of the most ancient cultures of physical education, is a physical, mental and spiritual discipline and it has been made part of curricular program in Sports University of Tirana (SUT). We took the responsibility to study the equilibrium quality as a discipline which has never been studied before in Albania. The aim of this study is to assess how postural sway is affected in two different conditions, Eyes Open and Tandem Eyes Closed tests in balance training through yoga exercises. One of the most important yoga exercises is balance training. This training helps in improving coordination system in static and dynamic activities. Before, yoga exercises had been used to build and to maintain the physical conditions, later on this concept has been extended in the balance training and used to improve physical parameters. The reason for describing such exercises is to explain the benefits of yoga exercises to the equilibrium system.

Key words: *balance training, yoga exercises, 1L_EO, TanEC, Sway Area, equilibrium, Sway Index*

Introduction

Yoga, one of the most ancient cultures of physical education has been made part of curricular program in Sports University of Tirana (SUT). We took the responsibility to study the equilibrium quality as a discipline which has never been studied before in Albania.

Yoga is a physical, mental and spiritual practice or discipline, which originated in India and includes a variety of schools, practices and goals. Yoga as a disciplined method for attaining a goal (Jacobsen & Lama, 1998), incorporate systematic exercises and self-development techniques of controlling the body, mind and spirit (Bryant, 2011; Samuel & Geoffrey, 2008). One of the most important yoga exercises is balance training. This training helps in improving coordination system in static and dynamic activities. Before, yoga exercises had been used to build and to maintain the physical conditions, later on this concept has been extended in the balance training and used to improve physical parameters.

Many studies have tried to determine the effectiveness of yoga in different pathologies, such as cancer, schizophrenia, asthma, chronic low back pain (Tilbrook et al., 2011), and heart disease. The results of these studies have been mixed with cancer studies (Smith & Pukall, 2009), suggesting none to unclear effectiveness, and others suggesting yoga may reduce risk factors and aid in a patient’s psychological healing process (Vancampfort et al., 2012). The studies for yoga as exercise or alternative medicine have been reported the potential benefits for adults and physical injuries from yoga practitioners too (Penman, Cohen, Stevens, & Jackson, 2012; Summers & Kathleen, 2012). Many long-term users have reported musculoskeletal and mental health improvements, as well as reduced symptoms of asthma in asthmatics (Birdee et al., 2008). Regular yoga has been shown to improve mood and anxiety more than some other metabolically-matched exercises, such as walking (Streeter et al., 2010). Three main focuses of yoga: exercise, breathing and meditation, make it beneficial to those suffering from heart disease. Overall studies of the effect of yoga on heart disease, suggest that yoga may reduce high blood-pressure, improve symptoms of heart failure, enhance cardiac rehabilitation and lower cardiovascular risk factors (Harvard Heart Letter, 2010). Yoga is used for treatment of cancer patients to decrease depression, insomnia, fatigue and to increase anxiety control (De Stasio, 2008). Another study had showed positive effects on sleep, anxiety, quality of life and spiritual growth in cancer patients (Smith & Pukall, 2009). Yoga has also been studied as a treatment for schizophrenia (Yoga Health Benefits), it is observed as a complementary treatment which help to improve health related quality of life (Vancampfort et al., 2012) and quality of recovery index too (S.B.S. Khalsa, G.S. Khalsa, H.K. Khalsa, & M.K. Khalsa, 2008).

Even though the positive effect of yoga exercises are very evident, it has been criticized for being potentially dangerous and being a cause for a range of serious medical conditions, including thoracic outlet syndrome, degenerative arthritis of the cervical spine, spinal stenosis, retinal tears, damage to the common fibular nerve, etc. (Chusid, 1971). Some yoga practitioners do not recommend certain yoga exercises for women during menstruation, for pregnant women, or nursing mothers. However, breathing exercises and certain postures which are safe and beneficial for women in these categories are encourages (Christensen, 2012).

The aim of this study is to assess how postural sway is affected in two different conditions, Eyes Open and Tandem Eyes Closed tests in balance training, through yoga exercises.

Methods

Fifty healthy male and female subjects, aged 20-25 years old from Sports University of Tirana (SUT) and Albanian University (AU), participated in this study. The mean age was 21.14 years old for SUT subjects and 22.07 for AU

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subjects. The measurements were recorded in force plate Biomechanics Laboratory of SUT (Leonardo Mechanography GRFP, 2010) and the study was approved and provided by the Sports University of Tirana. The balance testing Romberg protocol was used to collect the data, in two different conditions: Romberg One Leg Open Eyes (1L_EO) and Tandem Eyes Closed (TanEC). Center of Pressure (COP) is simply the point location of the vertical ground reaction resultant force vector, which is easily measured using a force platform (Tallon et al., 2012). The COP is the response of the body to COG displacement. The Center of Gravity (COG) signal represents a real movement, the sway of the body inverted pendulum (Bendo, Skënderi, & Veveçka, 2014; Luigi, Morasso, Cristina & Spada, 2002).) The sway parameters were taken during the COP trajectory shifts, along the time interval of 10 second: relative Pathlength (velocity in mm/s); absolute Pathlength (in mm); standard ellipse Sway Area SA (in cm^2); Equilibrium Anterior-posterior Score EQ (in percentage); and Sway Index SI (in cm). Sway area is calculated by integrating the area of COP with regard to reference point, while the sway index was calculated by determining the distance from the COP shifts for each data points, as given in formula:

$$SI = \sqrt{SD(x^2 \times y^2)}/N$$

This study included a three months period, followed by a re-valuation (balance training in yoga exercises effect). The repeated measure analyses paired t-test was used to compare the mean differences in two conditions, 1L_EO and Tan EC balance tests, to see the effect of yoga exercises in equilibrium system. Statistical analyses were performed using SPSS version 17. A value of $p < 0.05$ was considered statistically significant.

Results

Table 1 shows the descriptive statistics in terms of means and standard deviations (SD) of all anthropometric parameters (age, height, weight and body mass index BMI) for SUT and AU subjects.

Table 1. Descriptive statistics of anthropometric for SUT & AU subjects.

Parameter	Mean ± SD (SUT)	Minimum (SUT)	Maximum (SUT)	Mean ± SD (AU)	Minimum (AU)	Maximum (AU)
Age	21.14±1.48	20.00	25.14	22.07±1.87	20.00	25.02
Height	1.76±0.08	1.58	1.91	1.69±0.08	1.54	1.86
Weight	69.95±10.49	47.70	86.80	67.68±10.19	50.30	88.10
BMI	22.62±2.38	17.71	27.40	23.69±2.28	19.90	26.26

In Table 2 are presented the descriptive statistics of postural sway parameters in both SUT and AU subjects, as well as the absolute change and the percentage of this change after balance training.

Table 2. Descriptive statistics and the difference of postural sway parameters for SUT & AU subjects

Parameter	Mean ± SD (SUT)	Mean ± SD (AU)	Subjects	Absolute change	Percentage of change
V1(EO)	96.18±26.69	110.94±49.71	SUT	23.94	24.90
V2(EO)	72.24±19.31	81.51±28.82	AU	29.43	26.53
V1(TanEC)	113.99±43.85	114.01±54.04	SUT	35.14	30.83
V2(TanEC)	78.85±32.66	81.23±33.56	AU	32.78	28.75
L1(EO)	961.42±266.92	1110.85±497.54	SUT	238.99	24.85
L2(EO)	722.43±193.17	815.13±288.21	AU	295.72	26.62
L1(TanEC)	1140.09±438.57	1140.24±540.40	SUT	351.48	30.83
L2(TanEC)	788.61±326.60	812.37±335.59	AU	327.87	28.75
SA1(EO)	13.67±11.70	11.15±5.62	SUT	6.7	49.01
SA2(EO)	6.97±2.93	7.20±2.36	AU	3.95	35.42
SA1(TanEC)	17.84±12.46	18.49±11.49	SUT	8.49	47.59
SA2(TanEC)	9.35±6.09	8.67±3.78	AU	9.82	53.10
Eq1(EO)	0.80±0.07	0.78±0.05	SUT	0.06	7.5
Eq2(EO)	0.86±0.03	0.82±0.05	AU	0.04	5.13
Eq1(TanEC)	0.71±0.08	0.73±0.04	SUT	0.07	9.85
Eq2(TanEC)	0.78±0.08	0.78±0.05	AU	0.05	6.85
IL1(EO)	2.43±0.81	2.59±0.60	SUT	0.8	31.62
IL2(EO)	1.63±0.42	2.19±0.63	AU	0.4	15.44
IL1(TanEC)	3.4±0.96	3.26±0.53	SUT	0.86	25.29
IL2(TanEC)	2.54±0.93	2.58±0.58	AU	0.68	20.85

Table 3 reports pair of variables compared in two different conditions during 1L_EO and TanEC balance tests, before and after yoga exercises training.

Figure 1 shows the graphs of variation for: a) relative Pathlength (mm/s); b) SA (cm^2); c) EQ (%); and d) SI (cm) for SUT subjects in EO condition test before and after yoga exercise training.

In Figure 2 are presented the graphs of sway parameters for SUT subjects in TanEC balance test before and after yoga exercise training.

While in Figure 3 are given these graphs for AU subjects in EO condition before and after yoga exercise training.

Finally, Figure 4 presents the graphs of sway parameters during TanEC balance test before and after training.

Table 3. Pair of variables comparison of SUT & AU subjects in 1L_EO and TanEC tests

Condition	Pair of variables	t-value (SUT)	t-value (AU)	p-value (SUT)	p-value (AU)
	V1(EO)-V2(EO)	7.742	4.436	0.000	0.001
1 Leg	L1(EO)-L2(EO)	7.702	4.455	0.000	0.001
Eyes	SA1(EO)-SA2(EO)	3.940	3.682	0.000	0.002
Open	Eq1(EO)-Eq2(EO)	-7.262	-2.774	0.000	0.015
	IL1(EO)-IL2(EO)	7.262	2.774	0.000	0.015
	V1(TanEC)-V2(TanEC)	7.995	4.702	0.000	0.000
Tandem	L1(TanEC)-L2(TanEC)	7.997	4.703	0.000	0.000
Eyes	SA1(TanEC)-SA2(TanEC)	5.398	4.228	0.000	0.001
Closed	Eq1(TanEC)-Eq2(TanEC)	-8.267	-4.369	0.000	0.001
	IL1(TanEC)-IL2(TanEC)	8.267	4.369	0.000	0.001

Discussion

In Table 2 is observed that in EO condition, the absolute change and its percentage are respectively: for velocity and pathlength smaller for SUT subjects compared to AU subjects; for SA; EQ and SI higher for SUT than AU subjects. While in TanEC condition, these parameters results: velocity, pathlength, EQ, and SI higher for SUT than AU subjects, meanwhile EQ Score is lower for SUT subjects compared to AU. In Figures 3/c, d and 4/c, d seems that after training the EQ score is clearly higher than before training, due to the effect of balance training through yoga exercises. The results show that EQ (AP) has increased (Fig. 3/c and 4/c) when SA has decreased, because of the sway index has increased. From these results, it is clear that yoga exercises in balance training had been more efficient for SUT subject compared to AU subjects, due to the better physical parameters and preparation of these subjects.

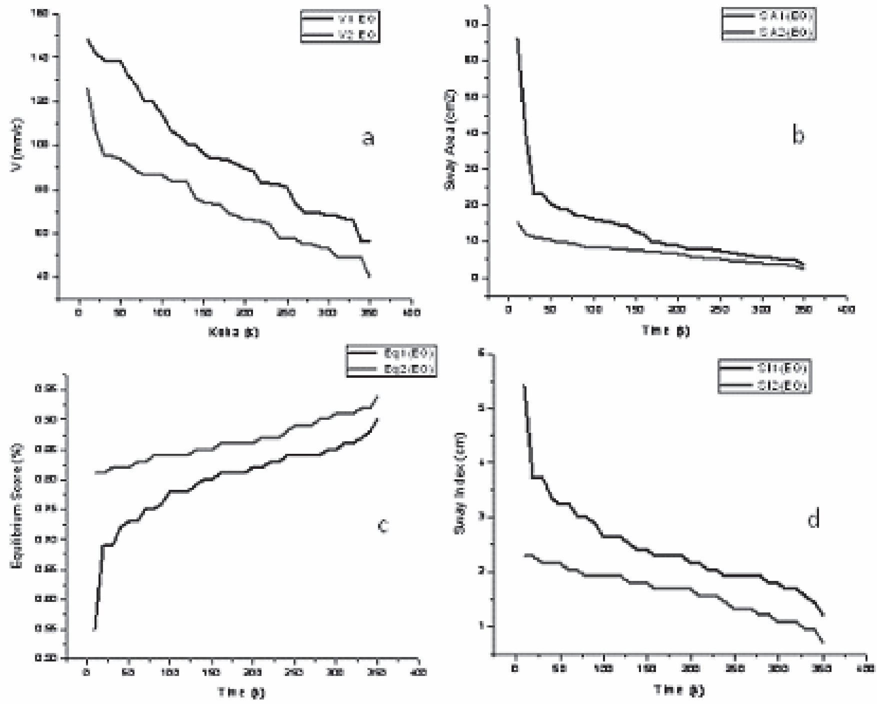

Figure 1. The graphs of sway parameters during time period in 1L_EO test for SUT subjects

The control analysis (paired t-test) shows that no essential difference between both SUT and AU subjects, despite the fact that the test is carried in EO or EC conditions, as it is reported by the respective values (t-values) and (p-values) in Table 3. The values reported in this table, gives the p-value ($p<0.05$) for both conditions of balance tests. At AU subjects, it is observed that p-values are a little bit lower in EC condition, compared to EO condition. This result is observed more clearly in Table 2, comparing the absolute change and its percentage in EO and TanEC condition for AU subjects. Hence the improvements have been more obvious in TanEC balance test, due to the effect of meditation. From comparison of the sway parameters of SUT and AU subjects, results that this improvement has been higher at SUT subjects, because of their prior physical preparation, improving health related quality of life (Vancampfort et al., 2012).

Eventually, three main sway parameters: SA and SI are statistically decreased due to the balance training in yoga exercises, while EQ scores are statistically increased. Therefore, the postural sway parameters are significantly changed compared to EO and TanEC balance tests before and after training, resulting in overall improvement of the body equilibrium system, because of yoga exercises.

Yoga has become a universal language of spiritual exercise in the world, crossing many lines of religion and cultures. Beside the spiritual goals, the physical postures of yoga are used to alleviate health problems and to reduce the stress. Yoga is also used as a complete exercise program and physical therapy routine. Millions of people practice yoga to improve their health and overall well-being.

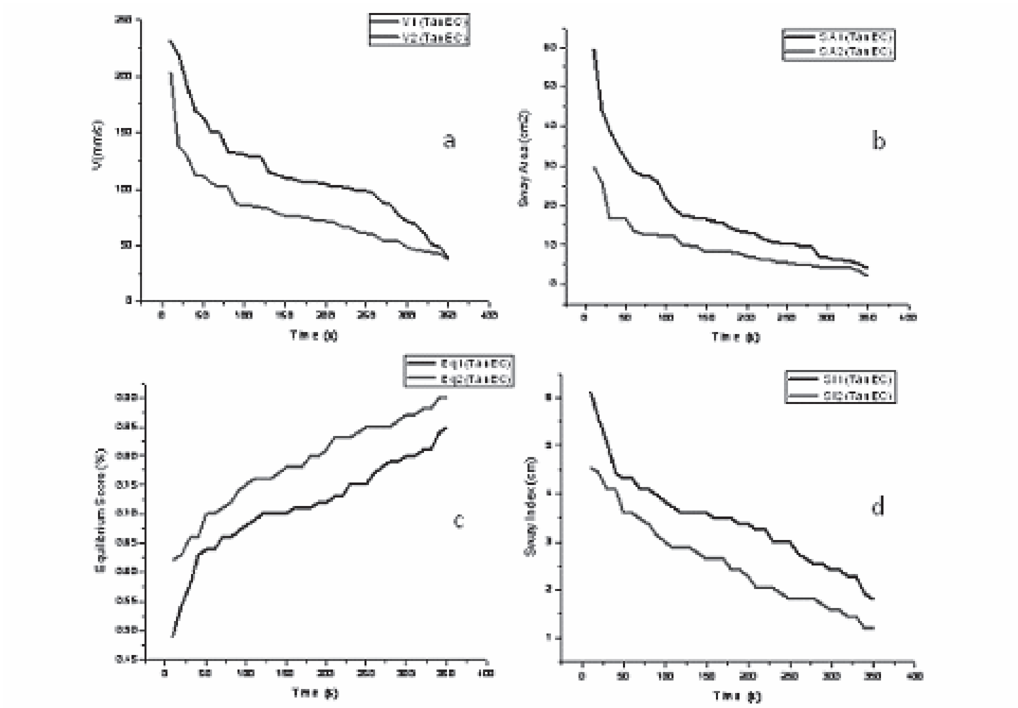

Figure 2. The graphs of sway parameters during time period in TanEC test for SUT subjects

The biomechanical parameters analysis pointed out significant statistical changes in one of the more important disciplines of movement expression, such as equilibrium. The results have verified the benefits of yoga exercises to the equilibrium system, as well as the necessity of these yoga exercises training development, to improve the life quality, even in other psychological and emotional dimensions.

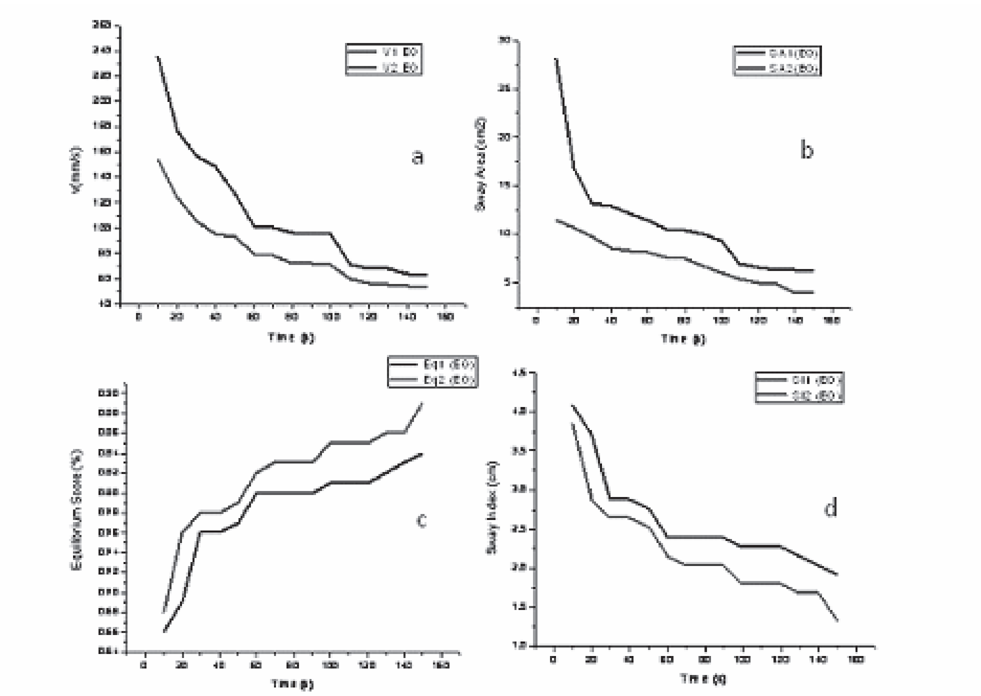

Figure 3. The graphs of sway parameters during time period in 1L_EO test for AU subjects

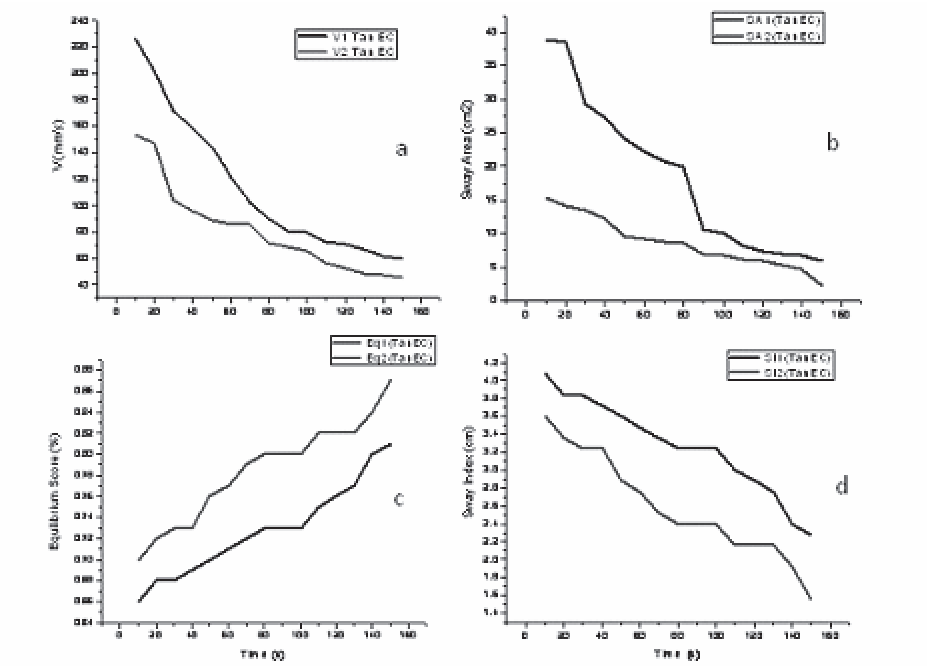

Figure 4. The graphs of sway parameters during time period in TanEC test for AU subjects

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