SUPPLEMENT

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Effects of Long-Term Training Program on Static and Dynamic Balance in Young Subjects

Abstract

Purpose: The purpose of this study was to examine the efficacy of a long-term training program of 10 weeks on static and dynamic balance parameters in a young healthy population.

Methods: Participants were 35 young healthy female subjects. Balance measurements were done using the Flamingo Balance Test (FBT) for static balance and the Star Excursion Balance Test (SEBT) for dynamic balance.

Results: Dynamic balance points increased and static balance points decreased after a 10 week training protocol compared with before training, indicating improvement in both dynamic and static balance.

Conclusions: These results indicate that long term training resulted in an improvement both static and dynamic balance. Training can be suggested for patients with balance problems.

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Balance is defined as the ability to maintain the line of gravity of a body within a base of support. Balance is a general notion that explains the dynamics that prevent the body mass from falling down. Balance is the ability of the body to provide an intended position while moving. For well-developed motor skills, it is essential for the body to stay upright to execute the required move. Balance is also defined as quick postural adaptation against changes in the center of gravity at the time of activity [1]. Maintaining posture and balance are related to each other but they are not the same thing. Balance covers preservation of posture, and substantially it is the coordination of muscular activity [2]. Balance is basis for a good motor performance and the ability to maintain balance can be defined as the determinant in other motor skills' development [3].

Balance can be grouped under two topics: static balance and dynamic balance. Static balance is defined as the ability of a subject to control postural sway during a standing stance. To sustain static balance, body mass should pass through second sacral vertebrae and stay on the base of support. Dynamic balance is defined as the ability of a subject to predict postural changes during movement, and to give appropriate responses to changes in balance [4].

Very complex neuromuscular mechanisms are required to maintain erect posture and to sustain balance during activity [5, 6]. There are three groups of receptors relating to balance and orientation: vestibular receptors; visual receptors; and, proprioceptive receptors. In various environments, for the body's upright stance and for maintaining balance related to gravity, the vestibular system, which is located in the inner ear, plays an important role. The vestibular system works with the information coming from various systems, such as auditory, visual and muscular systems. If the vestibular system shuts down for any reason; physiological and psychological problems, such as disorientation, losing balance when walking,

tinnitus, changes on heart rate and blood pressure, fear, anxiety and panic may occur [7].

Materials and Methods

Thirty five female volunteers (university students) participated in this research (median age = 18.54 years, SD = 1.01). A long-term training protocol of 10 weeks was put into practice.

Dynamic Balance

Dynamic balance was measured with SEBT. Participants lay down on the floor, which had been marked with a star pattern in eight directions, 45° apart from each other. The participants reached as far as possible with the reaching limb along each reaching line and, their reaching distant is recorded. The participants are given 180 seconds before the application and 120 seconds between gaps to get to know the test. Balance point is calculated with the formula, distance / leg length x 100 [8].

Static Balance

Static balance was measured with FBT. The participants maintain their balance on a plank balance tool that has 50 cm length, 4 cm height and 3 cm width. With FBT, the participant folds one leg at the knee and pulls it to the hip then holds the leg with the same side hand. While the participant is in balance like this, the timer is started and the participant tries to sustain balance for 1 minute. When balance is lost, the timer stops. If the participants get back up and maintain their balance, the timer continues from when it was stopped. This test lasts for 1 minute. Every attempt of the participant to maintain balance (after losing her balance) is counted and then it is recorded as the points of the participants [9]. In the FBT, small values (greater or equal to one) indicate a better balance score [10].

TABLE 1. Static and dynamic balance before and after long-term training

Parameters	Before (Mean $\pm$ SD)	After (Mean $\pm$ SD)	<i>t</i>	<i>P</i>
Dynamic balance of right leg	509.51 $\pm$ 46.37	544.46 $\pm$ 44.61	10.44	0.00
Dynamic balance of left leg	527.22 $\pm$ 52.53	567.2 $\pm$ 49.79	7.44	0.00
Static balance of right leg	12.74 $\pm$ 7.05	9.43 $\pm$ 5.45	9.29	0.00
Static balance of left leg	13.94 $\pm$ 8.61	10.23 $\pm$ 6.21	7.24	0.00
Mean dynamic balance	518.36 $\pm$ 47.72	555.83 $\pm$ 43.95	10.41	0.00
Mean static balance	13.34 $\pm$ 7.39	9.29 $\pm$ 5.57	9.56	0.00

For statistical analysis, IBM SPSS Statistics v21 was used. Descriptive statistics are done for demographic data analysis. Kolmogorov-Smirnov test was used to determine the normalization of data distribution. The distribution of data calculated parametrically and Paired Sample t test was used to calculate the difference between averages. For statistical significance p-value < 0.05 was used.

Discussion

In the present study, long-term training in young healthy persons resulted in improvements in both dynamic and static balance points. These improvements may be due to increase in the strength of antigravity muscles. Increased balance is not only valuable for general health but also for prevention of home and sport injuries.

Static and dynamic balance are affected in some neurologic diseases and senility problems. Balance deterioration in older adults limits activities of daily living and community participation, and is a significant risk factor for falls. One contributory element to this functional decline is impairment of anticipatory postural adjustments. In a recent study of six older adults, anticipatory postural adjustments-focused training of four weeks resulted in improved performance on clinical outcome measures. The authors suggested that a four-week anticipatory postural adjustments-based training program is feasible and could be effective in improving postural control, functional balance, mobility, and quality of life in older adults [11].

In older adults, diminished balance is associated with reduced physical functioning and an increased risk of falling. This is an update of a Cochrane review first published in 2007. In a recent meta-analysis study, authors suggested that there is weak evidence that some types of exercise (gait, balance, co-ordination and functional tasks, strengthening exercise, 3D exercise and multiple exercise types) are moderately effective, immediately post-intervention, in improving clinical balance outcomes in older people [12].

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