

# Unilateral Profile of Dynamic Balance of Female Students of Faculty of Sport and Physical Education

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## Abstract

The purpose of this study is to define indexes of unilateral dynamic balance on a basis of testing balance on Biodex Balance System, which will serve as a basis for a profile of physically active women – female students of FASTO.

The research involved 45 freshmen, sophomore and junior female students at FASTO, 15 students from each year. A sample of variables included a general stability index (GBI), lateral balance index (LDI) and frontal balance index (API). Results obtained from testing indicate that the index between the first and the second year varies for 15%, 13% between the second and the third year while the difference between the first and the third year of study is only 2%. There was even less difference with lateral balance index (LDI): the difference was 8% between the first and the second year, 3% between the second and the third year and 6% between the first and the third year. Comparing index of frontal balance (API) we obtained almost identical results, with slightly stressed differences. The difference between the first and the second year was 18%, 19% between the second and the third year and the difference between the first and the third year of study was only 1%. The obtained results indicate that there is no statistically significant difference in balance indexes and practical training classes do not have enough influence on a development of unilateral dynamic balance.

Key words: **unilateral balance, profile, female students**

## Introduction

Balance as an ability represents a prerequisite for performance of a great number of moving activities such as standing, walking running and so on. Adequate balance is necessary for man's movement through space and for numerous daily dynamic activities.

Balance represents an ability to control a stable body position during standing and during moving. In other words, it is an ability to establish and maintain a balance posture of body mass centre. In sport it is very important for changing direction of moving in complex situations (Marković and Bradić, 2008) and in daily life it is necessary for walking and performance of daily physical activities. Therefore, ability to maintain a balance posture is visible in static and dynamic conditions.

The field of balance is only partially explored all over the world. That partiality is especially related to healthy, young, physically active women. There are very few works which directly explored balance of female students. Standard tests and measuring of balance enable assessing of a functional performance. Traditional balance tests are focused on maintenance of body posture (static balance), balance during moving load or in motion (dynamic balance) and responses to external disturbances.

## Sažetak

Svrha ove studije je da se na osnovu testiranja balansa na Biodex Balance Systemu utvrde indeksi unilateralnog dinamičkog balansa na osnovu kojih će se formirati profil tjelesno aktivnih žena, tj studentica FASTO. U istraživanju je učestvovalo 45 studentica I, II i III godine FASTO-a, po 15 sa svake godine studija. Uzorak varijabli čine generalni indeks stabilnosti (GBI), lateralni balans indeks (LDI) i frontalni balans indeks (API). Rezultati dobijeni testiranjem pokazuju da se indeks između prve i druge godine razlikuje za 15%, između druge i treće za 13%, dok razlika između prve i treće iznosi samo 2%. Kod lateralnog balans indeksa (LDI) utvrdene su još manje razlike između prve i druge godine za 8%, druge i treće godine za 3%, prve i treće godine za 6%. Gotovo jednake rezultate s nešto izraženijim razlikama dobili smo upoređivanjem indeksa kod frontalnog balansa (API), tačnije, prva i druga godina za 18%, druga i treće za 19%, dok je razlika između prve i treće studijske godine samo 1%. Dobijeni rezultati ukazuju na to da ne postoje statistički značajne razlike u indeksima ravnoteže, te da praktična nastava nema dovoljno uticaja na razvoj unilateralnog dinamičkog balansa.

Ključne riječi: **Unilateralna ravnoteža, profil, studentice**

Static control includes standing on both legs, standing on one leg, tandem posture (position heel-toes), Romberg's test with open and closed eyes, aggravated Romberg's test in tandem feet position with open and closed eyes (Šarabon *et al.*, 2009).

Dynamic examinations of balance include straight standing, walking, turning, stopping and moving (O' Sullivan and Schmitz, 2001). Many of these tests do not correlate with dynamic nature of sport activities and are too simple to indicate deficits in balance of healthy physically active sportsmen (Riemann *et al.*, 1992). Therefore, these tests are less appropriate or even inappropriate for usage in sport and sports diagnostics.

Clinical and field measuring usually applied subjective ways of assessing and therefore there was a lack of reliability in measuring (Emery *et al.*, 2007). If someone wants to apply clinical balance measuring in rehabilitation and prevention, it is very important to use measures with a defined reliability and sensitivity (Burger, 2003).

For a purpose of this study and formation of dynamic balance profiles of female students of the Faculty of Sport and Physical Education, we used a sophisticated laboratory equipment Biodex Balance System. This diagnostic system can measure and compare proprioceptive disbalance with existing normative ranges in an objective and reliable way.

One of the researches (*Bressel et al., 2007*) compared static and dynamic balance of female football players, female basketball players, female gymnasts and female athletes. The study involved 34 female students -volunteers. Authors concluded that female football players and female gymnasts did not differ in regard to static and dynamic balance. Female basketball players were inferior then female gymnasts in static balance, while they showed a way better result than female football players in dynamic balance.

The study (*Santos, Rogerio, Garsia, & Cohen, 2004*) had a purpose to define normative values of a stability index on Biodex Balance System for unilateral and bilateral balance of junior tennis players who did not have and preceding history of injures. The testing was done three times per 30 seconds for unilateral and bilateral posture with 45-second breaks between the tests. Both of the tests (unilateral and bilateral) were started at level 8 (the most stable). The tests were decreased for one level at every 3.75 seconds until level 1 was reached (the most unstable). After all of the three tests were conducted, a special software presented the stability index data which were recorded. The result of the study was sent for analysis in order to define normative values of the stability index of junior tennis players. This is one of the rare studies that dealt in similar topic.

## Methods

### Sample examinees

Sample examinees were 45 freshmen, sophomore and junior female students of the Faculty of Sport and Physical Education of the University of Sarajevo who had not have a history of injuries of lower limbs in the last two years. A research conducted by Willem's at al. in 2002 showed that there were not any statistically significant differences between groups of examinees with no history of injuries of legs in the last two years and last three to five years in regard to strength and balance. Therefore it is presumed that a period of two years with no injuries of legs was sufficient for this research.

### Sample variables

- ATV – body height
- ATM – body mass
- BMI – body mass index
- GBI – general balance index
- LDI – lateral balance left – right (media – lateral)
- API – frontal balance forward – backward (anterior – posterior)

Balance in dynamic conditions was tested with Biodex Balance System for balance measuring. This research tested unilateral stability of a dominant leg.

### Testing protocol

Test - MBYS, Biodex Balance System - maintenance of balance on a computer-controlled mobile platform.

Time of work: An assesment of a total duration of the test for one examinee is 3 minutes.

Number of examiners: 1 examiner.

Requisites: Biodex Balance System, a computer – controlled platform.

Description of a place of performance: The test is done in a room of minimum dimesnion of 2x2 metre.

Task:

Examinee's initial posture: Holding handles, a barefoot female examinee stands on a circular platform. The examiner explains the task, and afterwards sets the platform free and the examinee does one trial. The female examinee chooses feet position on the platform alone. The examiner enters coordinates of the feet position chosen by the examinee as well as age, weight and height of the examinee and a level of test. (This research uses the 5th stability level)

Task performance: When the examinee is ready she removes her hands from the handles and the examiner presses «start» taster and the task starts. The task lasts for 20 seconds.

Stability index represents a variance of movement of the platform in degrees from normal level. Huge values of stability index indicate that an examinee has a problem with balance maintenance. Examinee's current stability index is written in Predictive Values Report under column called Actual Values.

Current values of stability index of an examinee can be compared with existing normative values. If stability index values differ from predictive normative values, it can be concluded that there is a problem with balance. Anterior/Posterior Stability Index is a variance of moving and deviation of the platform (in degrees) from a normal level of frontal plane.

Medial/Lateral Stability Index is a variance of moving of the platform (in degrees) from normal level in sagittal plane.

Method: testing on Biodex enables an assessment of balance in posture on one or two legs. Results of examination are compared with normative values depending on age and sex (*Balance System SD, Operation service/manual*).



Picture 1. Biodex Balance System SD

### Objectives of work

A basic objective of this research is to define differences in indexes of unilateral dynamic balance among female students of various years of study at Fasto, and to form (on a basis of obtained results) a profile of unilateral dynamic balance. The second objective of this study is to test effects of practical training classes on a transformation of balance as a motor ability.

### Data analysis method

Descriptive statistics (means and SD) were calculated. Oneway analysis of variance (ANOVA) and Bonferroni corrections for multiple comparisons were used for analyzing the differences in general, lateral and frontal balance index. In case an overall F test has shown

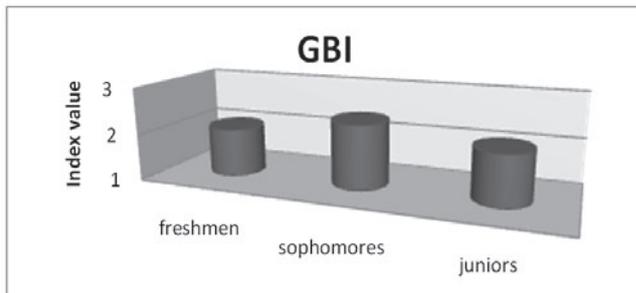
significance, a series of ANOVAs and Bonferroni multiple comparisons tests were performed to evaluate differences in each measured balance variable among the 3 groups. The level of statistical significance was set at  $p \leq 0.05$ .

### Results and Discussion

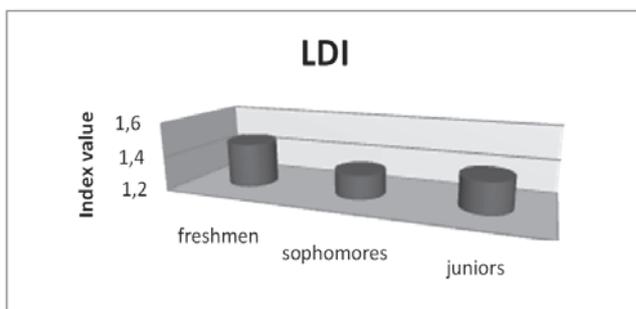
A morphologic status of the female students who were involved in this study show that this research was conducted with physically active female population – full time students of the Faculty of Sport and Physical Education. This is confirmed with an average value of body mass index (BMI) of all of the three years of study (about 21). Table 1 also shows that all of the three years of study slightly differ in all of the three applied morphologic variables.

**Table 1.** Descriptive statistic parameters of morphologic status of female examinees of all of the three years of studies

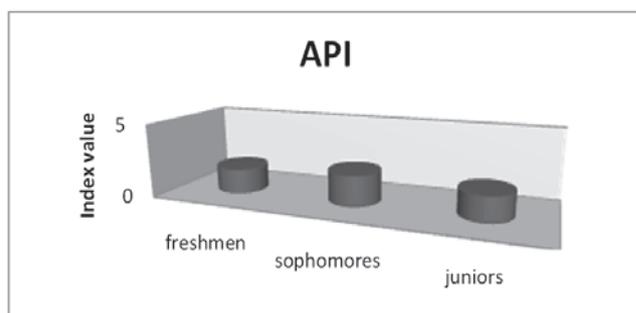
	Group	No.	Arithmetic mean	Standard deviation	Minimum	Maximum
Body height	1	15	166.467	6.1513	151.0	174.5
	2	15	168.400	5.1831	158.5	176.5
	3	15	168.133	4.9189	161.0	177.5
	Total	45	167.667	5.3883	151.0	177.5
Body mass	1	15	59.333	6.4300	45.5	72.0
	2	15	61.267	7.1286	54.0	77.0
	3	15	62.333	7.7452	47.0	75.0
	Total	45	60.978	7.0702	45.5	77.0
BMI	1	15	21.567	1.8741	18.2	24.5
	2	15	21.407	2.0869	18.5	25.7
	3	15	21.967	1.9126	18.1	24.9
	Total	45	21.647	1.9297	18.1	25.7



**Figure 1.** General balance index for all of the three years of study



**Figure 2.** Lateral balance index for all of the three years of study



**Figure 3.** Anterior-posterior balance index all of the three years of study

**Table 2.** Results of Univariate analysis of variances for applied stability indexes

		Sum of Squares	df	Mean Square	F	Sig.
<b>GBI</b>	Between groups	1.123	2	.562	1.151	.326
	In groups	20.489	42	.488		
	Total	21.612	44			
<b>LDI</b>	Between groups	.102	2	.051	.146	.864
	In groups	14.617	42	.348		
	Total	14.719	44			
<b>API</b>	Between groups	1.524	2	.762	1.457	.245
	In groups	21.968	42	.523		
	Total	23.492	44			

**Table 3.** Multiple comparisons of differences in applied indexes of all of the three years of study

ANOVA									
Depending variable	(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval			
						Lower Bound	Upper Bound		
<b>GBI</b>	1	2	-.3533	.2550	.520	-.989	.283		
			3	-.0400	.2550	1.000	-.676	.596	
		2	1	.3533	.2550	.520	-.283	.989	
			3	.3133	.2550	.678	-.323	.949	
		3	1	.0400	.2550	1.000	-.596	.676	
			2	-.3133	.2550	.678	-.949	.323	
	<b>LDI</b>	1	2	.1133	.2154	1.000	-.424	.651	
			3	.0800	.2154	1.000	-.457	.617	
		2	1	-.1133	.2154	1.000	-.651	.424	
			3	-.0333	.2154	1.000	-.571	.504	
		3	1	-.0800	.2154	1.000	-.617	.457	
			2	.0333	.2154	1.000	-.504	.571	
<b>API</b>	1	2	-.3800	.2641	.473	-1.039	.279		
		3	.0200	.2641	1.000	-.639	.679		
	2	1	.3800	.2641	.473	-.279	1.039		
		3	.4000	.2641	.412	-.259	1.059		
	3	1	-.0200	.2641	1.000	-.679	.639		
		2	-.4000	.2641	.412	-1.059	.259		

A basic prerequisite of authors of this study was expectation of existence of significant differences in indexes of unilateral dynamic balance among female students of various years of study of the Faculty of Sport and Physical education. One of presumptions also was that there would be significant differences in partial stability indexes, anterior-posterior and lateral balance indexes. Hypothetically speaking, one expected a positive trend of development of unilateral dynamic balance from the first to the third year of study. It was logical to assume that the second year would have better results in regard to dynamic balance, and lower mean value of all of the three applied indexes. It could be expected that the third year would achieve better results in this field of research.

It is realistic to expect that preceding regular classes in two semesters for the second year and in four semesters for the third

year had a positive effect on development of balance as a motor ability and that presumptions about a positive trend of developed unilateral dynamic balance throughout years of study would develop. However, results of the univariate analysis (Table 2) show that there is no statistical significant difference of arithmetic men among all of the three years of study. Results of the univariate analysis (Table 3) of all of the three applied stability indexes show that there is no statistical significant difference of arithmetic men among all of the three years of study.

Therefore, the obtained results completely deny presumptions about a positive trend of development of unilateral dynamic balance throughout three years of study. Values of obtained balance indexes of female students show that the mean value of a general index indicates inverse results in regard to the expected trend

(Figure 1). Freshmen female students had mean value of about 2, sophomores about 2.4 and juniors 2.1. A conclusion is that less index value corresponds to a better dynamic balance. We can conclude that the first year of study has the best unilateral dynamic balance, then comes the third year and the second year has the worst results at this test. However, very small differences among arithmetic means of GBI per years of study of maximum index value of 0.4 indicate that practically there are not almost any quantitatively expressed differences in regard to balance among freshmen, sophomores and juniors.

On a basis of official normative values (*Balance Index, Compare your score to the age group of healthy active people*) a normal range of values of achieved indexes varies from 0.82 to 2.26 for a physically active female population with age range from 17 to 35. Comparing these results one can see that all of the three years of study are in an acceptable range of stability index and that their balance does not deviate from normal one significantly. If we assess the obtained results in more details, we can say that it is not surprising that there are no statistically significant differences among years of study in regard to any of the applied balance indexes. Very small differences among arithmetic mean of all applied indexes and a great variability of results of all of the three years of study contribute to non-appearing of a statistically significant difference among the years of study.

An addition to given explanations is contained in calculation of percentage value of differences per all balance indexes and among three groups of examinees. In regard to that, percentage differences in applied stability indexes among years of study show that the first and the second year differ for 15% at a general level, the second and the third differ for 13%, and the first and the third differ for 2%. Stability in a sagittal plane (Figure 2) shows even less difference so freshmen and sophomores differ in 8%, sophomores and juniors in 3%, while difference between freshmen and juniors is only 6%. Similar results, with somewhat stressed differences, can be visible with anterior – posterior stability (Figure 3) where freshmen and sophomores differ in 18%, sophomores and juniors in 19%, while difference between freshmen and juniors is only 1%.

The reason of such results has to be looked for in the Curriculum and teaching materials used during classes from the first to the third year of studies. It is obvious that the teaching material for these years of study generally does not cause almost any transformation in balance as one of motor abilities. Furthermore, we have to mention that balance index testing represents a very sophisticated process which slightly discriminates groups of inhomogeneous character, such as groups in this study.

Although a number of researches dealing in defining a profile of motor ability level and effects of Curriculum and teaching material is small, some of the latest studies about strength support the explanation given for the results of this research. Results of such a research conducted with physically active women/students clearly showed that full time classes in the summer semester of the first, second and third year of study lasting for ten weeks did not represent a satisfactory stimulant of a (supra limit) volume sufficient to produce statistically significant changes in the volume of strength of female students (Kovačević, 2009).

In the end, one can say that very few teaching materials and activities of full time practical training classes are intended to improve all balance indexes and general level of this motor ability. This raises additional issues grounded in the fact that a number of unilateral physical exercises is small. Actually, the results of this research confirm this quotation in the best way.

## Conclusion

Analyzing the results obtained from testing the general and special indexes on Biodex Balance System, we draw the following conclusions:

- There are very slight differences among arithmetic means of GBI per years of study
- Maximum values of index of 0.4 indicate that there is almost no quantitatively expressed differences in regard to balance between freshmen and juniors
- Results of partial API and LDI indexes also indicate negligible differences
- Results obtained for mean value of the general index are 2 for freshmen, 2.4 for sophomores and 2.1 for juniors, and they indicate inverse results in regard to the expected trend. However, according to official normative values, which are 0.82 – 2.26 for physically active females from 17 to 35, one can conclude that all of the mentioned years of studies are in an acceptable range of the stability index and their balance does not deviate from the normative values. The cause of such results should be looked for in the teaching materials and the Curriculum for freshmen, sophomores and juniors, which obviously do not cause almost any transformation of balance as a motor ability.

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