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Original empirical article

THE DIFFERENCES IN THE BIOMECHANICAL CHARACTERISTICS OF THE DROP JUMP FROM AN ELASTIC SURFACE IN WOMEN

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Abstract. *The sample of participants included 20 female students from the Faculty of Sport and Physical Education in Niš. The research involved the use of the drop jump in sports gymnastics, performed from two different heights (40 and 50cm) from an elastic surface. The subject matter of actual research were the dynamic parameters of movement determined during the so-called drop jump (DJ), using the Myotest apparatus to measure the: height (in cm), power (in W/kg), force (in N/kg) and velocity (in cm/s). The obtained data were statistically processed by using the Descriptive statistics, the ANOVA and the Canonical-discriminant analysis. It was concluded that the results were better for all the studied parameters, when the Drop Jump was performed from a height of 50cm. This refers to the numerical parameters, but the statistical significance was determined only for the power parameter (0.00).*

Key words: *sports gymnastics, the drop jump, elastic surface, dynamic parameters of movement, canonical-discriminant analysis.*

INTRODUCTION

Social and economic progress is conditioned by the extent of the development of the scientific consciousness. Scientific research should represent the basis of high technical-technological development so that scientific activity could be considered a part of the systematic and planned work within involving various field of human life. Sports science,

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as a young scientific discipline develops in accordance with the potential economic and technological development of society. The improvement of sports results depends to a great extent on the results of scientific-research work. Types of sports in which success is based on many years of planning and the programming of sports form lead to acclaimed top sports results, as part of a continuous process. Sports activity is based on movement habits which are specific to each sport. The specific nature of certain disciplines is based on some of the characteristic interactions, at the core of which we find various types of movement ability. In sports activities, different types of interaction take place generally in the form of bodily collision, both in collective and individual sports. Jumps and drop jumps are just one type of collision, as are jumping over an obstacle and acrobatics in gymnastic sports, where bodily collisions with a piece of gymnastic equipment create a takeoff impulse achieved with either the hands or the feet. The term drop jump refers to a jump which takes place immediately upon a jump off a platform or from some other elevated position, at a certain or estimated height (Dabović, 2004, 2). In sports gymnastics, the drop jump is also known as the 'altitude drop'. The drop jump, based on the duration of the contact and the amplitude of the movement in the active joints is divided into the bounce drop jump, during which the duration of the contact with the surface is smaller and the amplitude of movement in the joints is smaller, and the counter drop jump, where the duration of the contact with the surface is longer and the amplitude of movement in the joints is greater (Bobbert at al., 1987a). The bounce drop jump is considered to be more effective in the development of the capacity to manifest muscle strength, while the counter drop jump is better for developing coordination (Bobbert, 1990). In the research of Asmusen and Bonde-Petersen (1974) it was determined that the greatest jump height for the drop jump occurs from a platform at a height of 40 cm. The jumps were selected for three initial heights (23cm, 40cm and 69cm) and at the time, the difference between the bounce drop jump and the counter drop jump was not taken into consideration. Bobbert et al. (1987a, b) recommended that the bounce drop jump be performed from a height between 20 and 40cm. They cited that in the jumps from a height of 60cm, the jump technique cannot be performed properly, and that there is a greater chance of ligament damage. Lees & Fahmi (1994) determined the greatest values for jump height, taking into consideration the component of the surface reaction force, the velocity and strength of the drop jump from a height of 12, 24, 36, 46, 58 and 68cm, was determined for jumps from a height of 12cm. The research carried out by Dabović (2004) which included the students of the Faculty of Physical Education in Belgrade, and which had as its aim to determine the strength and intensity of the increase of the leg extensor muscle for the performance of the drop jump. The obtained dynamic characteristics of the lower extremity extensors were compared with the heights achieved for the counter drop jump and the force exhibited in the bounce drop jump, performed from a height of 20, 30, 40, 50, 60 and 70cm. In the research carried out by Vanrentergema et al. (2004), the vertical jump was performed with an adaptation of movement to sub maximal load. The aim of above stated study was to gain insight into the kinematic and kinetic parameters of the vertical jump when jumping for different heights and to investigate movement effectiveness as a criterion for movement control in submaximal jumping. In order to determine the height of the jump, it was used the technique of the counter movement jump. From a standing position, vertical jumps were performed attempting 100%, 75%, 50% and 25% of the maximal height for a group of 10 participants. It was determined that the jump height increased due to the increase in vertical velocity at the take-off, which was pri-

marily related to an increase in the amplitude of the counter movement jump. The main aim of actual research was to determine if there is a statistically significant difference in variables of the drop jump protocol performed from the two different heights (40cm and 50cm) from an elastic surface.

THE METHOD

The sample of participants included twenty female students extracted from the population of students of the Faculty of Sport and Physical Education of the University of Niš. The research included the performance of a drop jump by technique comparable to the one made during the countermovement jump (Bobbert et al., 1987a; Harman et al., 1990), and positions of the two different heights (40 and 50cm) from an elastic surface placed on the ground. The elastic surface was represented by means of a SPIETH spring board, which is one of the authorized and attested manufacturers of gymnastics equipment. The research was carried out in accordance with the Helsinki declaration, with the written consent for the participation of all of the participants in the research. The subject matter of the research were the dynamic parameters of movement i.e., height (in cm) of the drop-jump from 40cm (ŽH40EP) and 50cm (ŽH50EP), power (in W/kg) of the drop jump from 40cm (ŽP40EP) and 50cm (ŽP50EP), force (in N/kg) of the drop jump from 40cm (ŽF40EP) and 50cm (ŽF50EP) and velocity (in cm/s) of the drop jump from 40cm (ŽV40EP) and 50cm (ŽV50EP). Mentioned parameters were determined by the usage of the instrument Myotest (Bubanj et al., 2010). As a data processing method, the central and dispersion parameters of descriptive statistics were used (Petković, 2000). By using the ANOVA method (analysis of variance) the differences were determined between the predictor and criterion at the univariate level, while the Canonical-discriminant analysis was used to determine the differences at the multivariate level. The data processing was carried out using the Statistics 6.0 program.

RESULTS WITH DISCUSSION

Table 1. The central and dispersion parameters in women for the jump from an elastic surface at a height of 40cm and 50cm.

Variables	N	Mean	SD	Skew	Kurt
ŽH40EP (in cm)	20	29.43	5.269	0.5405	0.7318
ŽH50EP (in cm)	20	32.68	8.089	0.4756	-0.0213
ŽP40EP (in W/kg)	20	59.66	8.390	-0.1058	0.0408
ŽP50EP (in W/kg)	20	65.27	13.781	0.0003	-1.2380
ŽF40EP (in N/kg)	20	43.23	3.192	-0.5194	-0.4260
ŽF50EP (in N/kg)	20	46.43	3.927	-0.7596	-0.3337
ŽV40EP (in cm/s)	20	238.35	21.938	0.3346	0.2487
ŽV50EP (in cm/s)	20	249.10	31.689	0.3629	-0.4465

The means of all the parameters of the drop jump from an elastic surface is greater in the case of the female participants who performed the drop jump from a height of 50cm. The standard deviation (SD), as an indicator of the dispersion of the results, indicates that

the results are more homogenous in the case of the drop jump from a height of 50cm, which leads to a great sensitivity of the results (smaller values - a more homogenous sample). The Skewness ranges approximately around zero or is symmetrically below zero, which can indicate that the test may have been too easy. The kurtosis (Kurt) has greater negative values, so the results are more dispersed.

Table 2. shows the values of the parameters of height, force and velocity, which indicate that there are no statistically significant differences between the drop jump from a height of 40cm and 50cm from an elastic surface in women. Only the values of the power parameter exhibit a statistically significant difference of 100%.

Table 2. The ANOVA (analysis of variance) of the differences between the jumps from an elastic surface at a height of 40 cm and 50cm in women.

Variables	Group	F	p
HEIGHT	El 40	2.259969	0.141023
(in cm)	El 50		
FORCE	El 40	2.417979	0.128240
(in N/kg)	El 50		
POWER	El 40	7.971750	0.007523
(in W/kg)	El 50		
VELOCITY	El 40	1.555882	0.219902
(in cm/s)	El 50		

Table 3 shows the differences in the drop jump from an elastic surface from a height of 40cm and 50cm in women. Using the multivariate canonical-discriminant analysis we isolated a single canonical factor which was explained by 58% (Can R =0.577), where the existing statistically significant explanation for the mentioned difference is 100% (p =0.00).

Table 3. The canonical-discriminant analysis of the jump from an elastic surface at a height of 40 cm and 50cm in women.

	Eigen value	Canonicl R	Wilks' Lambda	Chi-Sqr.	df	p-level
0	0.500708	0.577622	0.666352	14.61373	4	0.005573

CONCLUSION

On the basis of the research results it can be concluded that the drop jump from an elastic surface was better in all the studied parameters, when performed from a height of 50cm, which is confirmed by the results in Table 1. This refers to the numerical parameters, but the statistical significance was determined only for the power parameter (0.00). The values for the force of the drop jump did not indicate a statistically significant difference due to the velocity parameter of the performance of the drop jump, nor did they show any significant differences due to the measuring protocol which demanded a takeoff in the same sequences, signaled by the sound of the Myotest apparatus. The values for the height of the drop jump from an elastic surface did not indicate any statistically significant differences due to the small difference in the height of the platform from which the drop jump was performed (only 10cm). The practical applicability of this research can be

found in the methodology of the training of the elements in the hurdles discipline, which uses an obstacle such as an elevated object positioned in front of the spring board (medicine ball among others) at a precise height of 40cm, so that the jump onto the spring board (elastic surface) was performed with extended knees. This enables the jump onto the board to be performed from a height of approximately 50cm, which is the most suitable height confirmed in this research.

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RAZLIKE U BIOMEHANIČKIM KARAKTERISTIKAMA PRI ODSKOKU SA ELASTIČNE PODLOGE KOD ŽENA

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Uzorak ispitanika obuhvatio je 20 studentkinja Fakulteta sporta i fizičkog vaspitanja Univerziteta u Nišu. Istraživanje je podrazumevalo primenu skoka iz saskoka u Sportskoj gimnastici, sa dve različite visine (40 i 50cm) sa elastične podloge. Predmet istraživanja predstavljali su dinamički parametri kretanja utvrđeni primenom uređaja Myotest, prilikom protokola skoka iz saskoka, tzv. Drop Jump-a (DJ): visina (u cm), snaga (u W/kg), sila (u N/kg) i brzina (u cm/s). Dobijeni podaci statistički su obrađeni primenom deskriptivne statistike, metode analize varijanse i kanoničko diskriminativne analize. Može se zaključiti da su rezultati bili bolji u svim parametrima kada je skok iz saskoka izvođen sa visine sa visine od 50cm. To se odnosi na numeričke vrednosti, a statistička značajnost je utvrđena samo kod parametra power (p=0.00).

Ključne reči: *sportska gimnastika, skoka iz saskoka, elatičnostična podloga, dinamički parametri kretanja, kanoničko- diskriminaciona analiza.*