The Utilisation of Plyometric Means in the Development of the Explosive Force in the UPB Cheerleading Team

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Abstract: Plyometrics is a method used in the development of the explosive force, which, by improving the springiness, can lead to obtaining high performances. The aim of this paper is the optimisation of the female students from the cheerleading teams by elaborating and implementing during the lessons of plyometric operational structures focus on developing explosive force. The research methods used in this study are: scientific documentation, observation method, experimental method, statistical-mathematical method, graphical and technical method for video recording used to assess the level of development of the explosive force. These were used to assess the level of the explosive strength development through the testing of three specific gymnastic jumps: the sissone jump, the nest jump, the long jump. The experimental research took place in the Sports Hall of the U.P.B. in the period of November 2016 - May 2017, on a sample of 16 students (divided into 2 groups: experimental and control), aged 19 and 20. The training program of the experimental group took place over 20 weeks in 40 lessons training, during which we applied the independent variable, respectively specific plyometric means. During the implementation of the experimental operational structure, put in practice on the basis of planned training lessons, we noticed significant progress in the experimental group compared to the control group with all the parameters evaluated and tested. The attestation and validation of the results obtained from the research carried out, highlights the efficiency of the newly introduced methods in the organization, the conduct and the objectivization of the training done with the experimental group. This represents a personal contribution aiming to improve the content of the instructive-educational process.

Keywords: *cheerleading; explosive strength; plyometric methods; students;*

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1. Introduction

"Long ago, the term cheerleader was known around the world and could be described as being represented by beautiful girls with an elegant posture, whose main purpose was to animate and capture the crowd's attention in the atmosphere of various team matches (soccer, American football, baseball, basketball, etc.) through movements made in a specific choreography with an exciting rhythm, and accessorized with pompons which give color to any choreography. Over time, everything has grown to become a very well-organized and structured activity on different levels and categories." (Stroescu, 2018: 2)

The term cheerleading comes from America. This is a very popular competition sport worldwide, transforming itself from an entertainment and leisure activity into a competitive one which is no longer "just for girls." (Grindstaff & West, 2006: 500-518.)

Cheerleading is a technical-combinational sport that blends kinetic elements of high difficulty with combinations of steps and arms movement, all of which are performed on the rhythm of the music that leads to the creation of an artistic act. In choreography, we find elements of great strength, both static and dynamic, elements of flexibility, suppleness and balance. Among the technical components of this sporting branch we can discover elements of difficulty specific to several gymnastic branches such as: artistic gymnastics, acrobatics, aerobic and rhythmic gymnastics. All these high-risk elements together with the dance elements contribute to creating a show due to the high level of performance. The beauty and virtuosity of the choreographies offers the audience a real spectacle, and this is a fact which has led to a considerable increase in the number of practitioners of this sports branch worldwide. This urges us to support the specialists in our country by providing them with concrete facts about some technical elements of difficulty that underlie cheerleading.

In our country this sport is still at the beginning, but it is starting to develop with small steps, both from a theoretical viewpoint by publishing articles or books (Dobrescu, 2016; Grigore & Manos, 2011; Grigoriu, Drăgulin, Leonte, & Popescu, 2015b) and from a practical point of view, by establishing the Cheerleaders Association of Romania and by organizing the National Cheerleaders Championship.

The overall objective in cheerleading, as well as in gymnastics, is to achieve sport craftsmanship by adapting the body of the female competitors to the specificity of the activity performed. The finality of this process is reflected in competitive performance, in relation to the potential of each

sportswoman, the level of classification and the concrete preparation which has been carried out. While in other sports disciplines such as athletics or swimming, the athletes' performance is judged by "how they ran" or "how they swam", in cheerleading it is important "what you executed" and "how you executed" (Jastrjemskaia & Titov, 2004: 1).

In cheerleading and beyond, emphasis is placed on developing the human body's ability to move and on the exceptional level of manifestation of the various motor and psychological components.

The specific physical training targets, according to the physiological particularities of the effort, the following motor components:

- ◆ "rapid force and explosive force;
- ◆ reaction and movement speed
- ◆ muscle strength located on body areas;
- ◆ general effort resistance" (Macovei, 1999: 63-64).

The problem of the explosive development is a vast subject of study, both from the theoretical and practical point of view, being a permanent concern of specialists from various sports fields - artistic gymnastics (Damian, Popescu, Oltean, Traicu, & Giurgiu, 2014), rhythmic gymnastics (Grigoroiu, 2015a; Santos, Lebre, & Carvalho, 2016), volleyball (Benedek, 2012; Făgăraș, Țurcanu, & Țurcanu, 2015), etc. and from various fields of activity - coaches, teachers, physiologists, methodologists, etc. Believing that explosive strength is an important motor component in achieving performance, we considered it appropriate to investigate the practical ways of its development by introducing plyometric means into the training of the female students.

The complex and dynamic nature of the technique, as well as the importance which has to be given to this factor in the process of training the young females, respecting the content and requirements of arbitration, has led us to document on the concrete ways of preparing young women and to try to find solutions, in line with the contemporary requirements, in order to optimize the physical training methodology.

2. Material and Methods

2.1. Research Aim

The aim of this paper is the optimisation of the female students from the cheerleading teams by elaborating and implementing during the lessons of plyometric operational structures focus on developing explosive force.

2.2. Research Hypothesis

The determination and rational use of certain plyometric operational systems can contribute to the development of the explosive strength of the female students aged 19 to 20 in the cheerleading team.

2.3. Research Methods

The research methods used in this study are: scientific documentation, observation method, experimental method, necessary "in order to verify the experimental idea" (Epuran, 2005: 246), statistical-mathematical method, graphical and technical method for video recording used to assess the level of development of the explosive force.

To assess the level of the explosive strength development, we tested three specific jumps from the rhythmic gymnastics with different detachment as a modality, from the spot and with momentum:

- the sissone jump – jump from the spot with impulse on both feet and landing on one foot;
- the nest jump – jump from the spot with impulse on both feet and landing on both feet;
- the long jump – jump from the spot with impulse on one foot and landing on the other foot.

Three repetitions were performed for each jump and the best result was recorded. The height of the jump was measured, taking the hip as a marker.

2.4. Subjects and Location

The experimental research was carried out on 16 female students from the University Politehnica of Bucharest, members of the cheerleading team, divided into two training groups, which for our project acquires the concrete significance of experimental group and control group:

- ◆ the experimental group – made up of 8 female students aged 19-20;
- ◆ the control group – made up of female 8 students aged 19-20.

For the present research we have obtained the informed consent of the subjects included in the experiment according to the legal requirements. All the subjects were notified in relation to the: aim of the research, the nature and the way the experiment is undertaken, the evaluation methods, as well as the risks and benefits involved in the activities. At the beginning and during the research, the subjects did not suffer from any ailments, were not under medical treatment and did not suffer medical injuries.

The experimental research was conducted over seven months, between November 2016 and May 2017:

- between November 1 and November 6, 2016, the initial testing took place;
- between November 7, 2016 - May 12, 2017, the training program was implemented that includes specific plyometric means only for the experimental group;
- between May 15 and 19, 2017, the final testing took place.

2.5. Results

After recording the data by means of video recordings in both groups of female students, a program of training with specific plyometric means was made, intervening on the training of the female students from the experimental group in order to optimize the explosive strength.

The training program was conducted over 20 weeks in 40 training lessons, with specific plyometric means. In the programming and dosing of the specific plyometric means, the female students' level of training was taken into account.

The results obtained in the two tests, initial and final, are shown in Tables 1-3 and graphically represented in Figures 1-9.

Table 1. The comparative analysis of the results obtained by the experimental group when assessing the explosive strength initial testing (IT) and final testing (FT)

TESTS	STATISTICAL AND MATHEMATICAL INDICATORS						
	$\bar{X} \pm \sigma$		Progress		Cv	t-TEST	
	I.T.	F.T.	I.T.-F.T.	I.T.	F.T.	BILATERAL	p
vertical jump	37,51cm/ $\pm 3,17$	39,08cm/ $\pm 3,93$	1,57cm	0.08	0.10	4,304	0,004
long jump	43,80cm/ $\pm 3,86$	45,64cm/ $\pm 4,03$	1,84cm	0.09	0.09	5,274	0,001
high jump	31,68 cm/ $\pm 2,56$	33,16 cm/ $\pm 2,51$	1,48cm	0.08	0.08	6,101	0,0005

Figure 1. Sissone Jump - Initial and final test results – the experimental group

Figure 2. Nest Jump - Initial and final test results – the experimental group

Figure 3. Long Jump - Initial and final test results – the experimental group

Table 2. The comparative analysis of the results obtained by the control group when assessing the explosive strength initial testing (IT) and final testing (FT)

TESTS	STATISTICAL AND MATHEMATICAL INDICATORS						
	$\bar{x} \pm \sigma$		Progress		Cv		t-TEST BILAT ERAL p
	<i>I.T.</i>	<i>F.T.</i>	<i>I.T.-F.T.</i>	<i>I.T.</i>	<i>F.T.</i>		
sissonne jump	35,30cm/ ±2,92	35,35cm/ ±2,94	0,05cm	0.08	0.08	1,528	0,170
nest jump	41,68cm/ ±4,03	41,65cm/ ±3,08	0,03cm	0.08	0.07	0,323	0,756
long jump	30,38 cm/ ±1,14	30,46 cm/ ±1,08	0,08cm	0.04	0.04	1,050	0,329

Figure 4. Sissone Jump - Initial and final test results – the control group

Figure 5. Nest Jump - Initial and final test results – the control group

Figure 6. Long Jump - Initial and final test results – the control group

Table 3. The comparative analysis of the results obtained by the experimental group (EG) and the control group (CG) at the final assessment of the strength

TESTS	STATISTICAL AND MATHEMATICAL INDICATORS						
	$\bar{x}/\pm\sigma$		Progress		Cv		ANOVA
	E.C.	C.G.	I.T.-F.T.	E.C.	C.G.	F	
sissonne jump	39,08cm/ $\pm 3,93$	35,35cm/ $\pm 2,94$	3,73cm	0.10	0.08	4,676	0,04
nest jump	45,64cm/ $\pm 4,03$	41,65cm/ $\pm 3,08$	3,99cm	0.09	0.07	4,947	0,04
long jump	33,16 cm/ $\pm 2,51$	30,46 cm/ $\pm 1,08$	2,7cm	0.08	0.04	7,812	0,01

Figure 7. Sissone Jump final test results (MEAN), the experimental group – the control group

Figure 8. Nest Jump final test results (MEAN), the experimental group – the control group

Figure 9. Long Jump final test results (MEAN), the experimental group – the control group

The objectivization of the subjects' training from the two research groups allowed the working hypothesis to be verified, by recording, processing and interpreting the quantified data. This objectivization process allowed to formulate certain conclusions of the experimental research, which based on the obtained data allowed the validation of the research hypothesis.

Following the training for the sissone jump test, the first point highlighted on the experiment group for this technical element is the considerable increase in the execution criterion, resulting in a high value on the exercise's assessment. The verification of the statistical hypothesis performed with the bilateral dependent t-test for this group shows a statistically significant difference between the averages $P = 0.004$ being lower than 0.05. (Table 1). In this situation the null hypothesis is rejected and the research hypothesis is accepted.

The second group of the study, the control group did not reveal significant data throughout the experimental research, according to the statistics performed by means of the bilateral dependent t-test. The differences between the averages, statistically insignificant, $P = 0.170$ being higher than 0.05 (Table 2), lead to the rejection of the null hypothesis and the research hypothesis.

The examination of the results through the ANOVA test (Table 3) shows that the comparison between the two groups is confirmed by the presence of a value $F = 4.676$ ($p = 0.05$ and $F_{critical} = 4.600$) in the benefit of the experimental group. The remarkable results obtained from this research confirmed the validity of the research hypothesis.

The results obtained from the nesting jump test revealed different values for the two groups of this research in both assessments. The improvement and correction of the female athletes technique in the experimental group led to high values after the bilateral dependent t-test, $P = 0.001$ being lower than 0.05 (Table 1). By comparing the results of the control group, we find an insignificant difference between the two averages, $P = 0.756$ is higher than 0.05 (Table 2). Following an adequate preparation of the entire training program, this element approaching a special technique in the physical training programs, the experimental group confirms the research hypothesis and rejects the null hypothesis. In the control group, since there is a slight regression following the second assessment, the null hypothesis is accepted and the research hypothesis is rejected.

The comparison of the whole set of results for the element of difficulty (the nest jump) for the female athletes of the two research groups through the ANOVA test (Table 3) ($F = 4.947$ for $p = 0.05$ and $F_{critical} = 4.600$) highlights the differences made by using the training process in favor

of the experimental group and thus we can state that the research hypothesis is confirmed.

The study of the jump with impulse from one foot with landing on the other (the long jump) led to the following results: the subjects in the experimental group showed an improvement of the execution of the technical element during the research and the control group showed an insignificant increase of the values achieved.

The experimental group confirms the research hypothesis following the statistical results of the bilateral dependent t test by a statistically significant difference between the averages, $P = 0.0005$ being lower than 0.05 (Table 1). This rejects the null hypothesis and the research hypothesis, and for the control group the null hypothesis is accepted and the research hypothesis is rejected, this being confirmed by the verification of the statistical hypothesis carried out by means of the bilateral dependent t test, which shows a statistically insignificant comparison between the averages, $P = 0.329$ being higher than 0.05 (Table 2).

Even though this assessment method did not pursue the collection of quantitative data, but produced the completion of the survey table, with qualitative aspects, it comparatively facilitated the work program throughout the research. The end of the experimental research distinguishes the two groups by these values of $F = 7.812$ for $p = 0.05$ and $F_{critic} = 4.600$ in favor of the experimental group (Table 3). This data entitle us to believe that the independent variable applied to the experimental group by elaborating and applying specific complex programs throughout the experiment is the one that made the difference in the preparation, the research hypothesis being confirmed.

3. Conclusion

Following the application of the experimental operational structures, materialized in practice based on the documents for the preparation planning, we noticed significant progresses of the experimental group compared to the control group with all the evaluated and tested parameters.

These differences can be explained by the different training program followed by the two groups (experimental and control), which confirms that the plyometric method used in the training of the investigated female students produced significant increases in the explosive strength, thus validating the hypothesis that underpinned the experimental approach.

The attestation of the results obtained by the experimental validation of the working hypothesis expresses the efficiency of the newly introduced

paths in the organization, development and objectivization of the training effected.

When plyometric means are used in the preparation, it is imperative that between the increase in the degree of the physical demand and the increase in the possibilities to cope with the physical demands used there should be an optimal relation. It is very important that the plyometric means be dosed and programmed very carefully and it is also of importance to take into account the age, the bone and muscular system development and the training level of the subjects.

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In this study all the authors had an equal contribution and are the main authors.

We declare that in this study all the ethics standards of research were respected, all the participants in the study were informed in relation to the voluntary character of the test participation, that they can withdraw in any moment without any negative repercussions and that they gave their consent to participate in the research.

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