Ss. Cyril and Methodius University in Skopje
**Faculty of Physical Education, Sport and Health**

# 2ND INTERNATIONAL SCIENTIFIC CONFERENCE

## RESEARCH IN PHYSICAL EDUCATION, SPORT AND HEALTH

# CONFERENCE PROCEEDINGS

Skopje, 03-05, June 2016

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# CONTENTS

# RELATION BETWEEN THE STANDING VERTICAL JUMP (ABALAK TEST), STANDING LONG JUMP, AND SQUAT JUMP 2 LEGS 5 JUMPS (OPTOJUMP) TESTS FOR ASSESSMENT OF THE EXPLOSIVE STRENGTH OF LEGS

**UDC: 796.431.2.012.424**

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**Abstract**

*The purpose of this study was to assess whether and if there is correlation between the applied tests for explosive strength of legs, so as to provide a recommendation when selecting tests for assessment of the explosive strength of legs.The subject of this research is the explosive strength of legs, tested at 36 examinees, male, age of 18-19 years. Three tests were executed: 1. standing vertical jump (SKOKVIS) – Abalak test , 2. standing long jump (SKOKDAL), 3. squat jump 2 legs 5 jumps – with optojump equipment. The examinees were divided into 3 groups. Each of the groups was randomly distributed in one of the 3 test places. Breaks of 5 minutes per examinee were given between tests. During testing, for the Abalak and standing long jump tests, the examinees have performed 2 attempts, and one attempt for squat jump 2 legs 5 jumps. The jump 2 legs 5 jumps test on optojump equipment was executed with hands on hips. Pearson's analysis was performed on the results of Abalak, standing jump and heights of optojumpt tests, as well as a multiple regression during which, as predictor variables, the output data were taken of the tests with optojump, for 1-contact time with surface (T.Cont), 2-flight time (T.Flight) and 3-Power as a output from the jumps, and the criteria results of Abalak, standing jump and heights of optojump. The Pearson's analysis has shown significant correlation between the results of the Abalaks, standing jump and heights of otpojump tests. Highest correlation (r=0.638, p=0.000) exists between the tests Abalak and standing long jump. Lowest, yet significant, correlation exists between Abalak and the height resulting from the optojump test r=0.466 (p=0.002). In the first multiple regression analysis where height is dependant variable, the entire system of predictor variables contributes to the analysis in a statistically significant manner (R=0.99, p=0.000). In case of a SKOKVIS dependant variable, the system of predictor variables, again, has statistically significant impact in the analysis (R=0,519, p=0.017). In this case, single contribution to significance is attributed to the variable T.Flight (p=0.017). In the third multiple regression for the dependent variable SKOKDAL, the analysis is statistically significant (p=0.007), and, once again, the main (single) variable for significance is T.Flight (p=0.03). Existence of correlation between the three included tests in this research has shown that, in method-related terms, tests are efficient when assessing the explosive strength of legs. Presumably, it can be recommended that those who shall apply the tests for explosive strength in legs shall have to choose the test they shall systematically apply, so as to show whether there are any changes of this ability following a treatment with exercises. One can conclude that, perhaps the time spent in the flight phase can in some way be used as a predictor on the reached height, during the testing of the standing vertical jump and the standing long jump.*

**Key words**: power, height, optojump, abalak, standing long jump, contact time

## Introduction

Explosive strength represents an ability during which there is combined exertion of strength and speed per unit of time (Jovanovski, 2013). Although it acts as a hybrid of basic abilities, nevertheless, the explosive strength is singled out, in factor terms, as a strength sub-factor (Kurelic, N. i sar. 1975). Unlike the speed strength, where speed is the dominant factor, the external resistance range is dominant as regards the explosive strength (Peric D., 1999). In general terms, while performing an explosive movement, successiveness exists in terms of engagement of motor mechanisms (abilities) in the following order: initial strength, accelerating strength, and absolute strength (Verhosanskij, 1992). The basic moment in the explosive strength manifestation is in the nervous-muscular apparatus, defined through the stretch reflex instinctively used by every human being in the performance of an explosive movement.

The explosive component of strength, through the genetic research, is related to the presence of muscular fibres responsible for the fast contractions, tested through the ACTN3 genotype and its mutation (Druzhevskaya et al., 2008; Eynon et al., 2009) (Niemi & Majamaa, 2005; Papadimitriou et al., 2008; Roth et al., 2008;). This relatively high heritability of explosive strength (h2=0.80), enables slight impact upon it by training, particularly in the sensitive period for this ability, at about 10-12 years of age (Jovanovski, 2013). In practice, the explosive strength exercises (in particular for the legs) are recognized as plyometric training (Radcliffe 2003), by using the jump method. During the performance of jumps, the strength transformation is due to the [1] eccentric movement phase, during which there is plyometric regime of muscle strength generation (Zatsiokrsky 1975), followed by [2] stretch reflex and reaction speed, in the domain of speed as an ability, as well as inter-muscular coordination for the purposes of more efficient transformation of the muscle work from plyometric to [3] miometric work regime, during which the strength is to be generated through concentric contraction so as to propel the body or object in the space. Therefore, there are different forms of jumps for development of the explosive strength of legs (Gaic M., 1985) preceded by, leap at a higher level, landing from higher to lower level or combinations thereof (Matic, 2015).

As a motor manifestation, explosive strength is embedded in part of the athletic disciplines (throwing, jumps, where it is most manifested), as well as in all other sports, with different contributions. Having in mind the genetic dominance fact (low transformation opportunity), this ability is also subject to testing for selection purposes. Therefore, during the selection of athletes, as well as prior to commencement of the training processes (preparatory period and similar), explosive strength assessment tests are used, so as to provide directions whether the level of this ability of the athlete is as required (Jamie f. Burr et all). Alternatively, the tests for explosive strength of legs are also used for the cyclic activities (running) for the purposes of assessing the impact of this ability on the performances in races (Paavolainen, L, et all 1999, Slattery KM. 2004, Spinks CD et all. 2007 Spurrs, RW, Murphy, AJ, and Watsford, ML. 2005, Chtara., et all, 2005,), as well as on the football performances (Wisløff, U, et all 1998, Wisløff, U et all 2004).

The test selection issue was of interest to us. Which test (of those subject to analysis) shall represent the assessment of the explosive strength of legs in the best manner? Whether each of the analysed tests can provide an answer to the assessment of this motor dimension in humans?

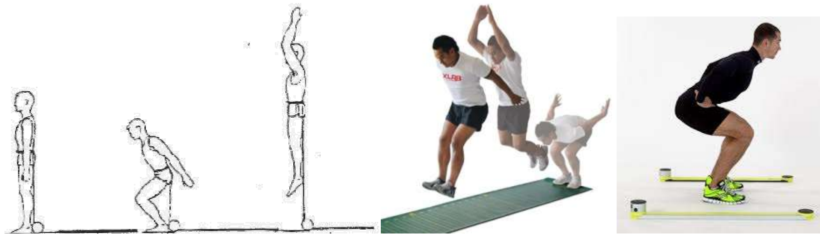
This research applies 3 tests for testing of the explosive strength in legs (herein explained). It is a common practice to recommend usage of apparatus in the form of a jumping mat or sensor devices for the purposes of more efficient testing, unlike the standard methods which use a tape measure or performing of calculations so as to obtain the value being measured (ISAACS, L.D. 1998). Therefore, it was our objective to assess whether and if there is a correlation between the applied tests, so as to provide a recommendation for selection of tests for assessment of the explosive strength of legs.

**Materials and methods**

The subject of this research is the explosive strength of legs, tested at 36 male examinees, at the age of 18-19 years.

3 tests were performed: 1. standing vertical jump (SKOKVIS) – Abalak test, 2. standing long jump (SKOKDAL), 3. squat jump 2 legs 5 jumps – with optojump equipment. The objective of the research was to assess whether there is correlation between the tests, for the purposes of their applicative use in practice. In addition, if there is such correlation between some of them, whether some of the indicators produced from the optojump test can be used (time of contact with mat - T.Cont, time in flight phase - T.Flight, as well as the performed work of the leg muscles in the type of power – Power) during the analysis and interpretation of obtained data from both standard test methods for explosive strength of legs (standing vertical jump (SKOKVIS) and standing long jump), through multiple regression.

he examinees were divided into 3 groups. Each of the groups was randomly distributed to one of the 3 test places. 5 minutes breaks were given between tests, per each examinee. During testing, the examines made 2 attempts for the Abalak and standing long jump tests, and 1 attempt for squat jump 2 legs 5 jumps. The jump 2 legs 5 jumps test, on the optojump apparatus, was performed with hands on hips.



**Results and discussion**

Pearson's analysis has shown significant correlation between the results of Abalaks, standing jump and heights of otpojump tests. The highest correlation (r=0.638, p=0.000) is between the Abalak and standing long jump tests. Standing long jump, with the predictive data on the achieved height of optojump, is with value p=0.536 (p=0.000). Lowest, yet significant, correlation exists between Abalak and the height obtained from the optojump testing r=0.466 (p=0.002).

*Table No. 1 Correlation table*

| Correlations coeff. | | | |
|---|---|---|---|
| N=36 | Height | SKOKDAL | SKOKVIS |
| Height | 1.000 | 0.536 | 0.466 |
| | | p = 0.000 | p = 0.002 |
| SKOKDAL | 0.536 | 1.000 | 0.638 |
| | p = 0.000 | | p = 0.000 |
| SKOKVIS | 0.466 | 0.638 | 1.000 |
| | p = 0.002 | p = 0.000 | |

The predictive value for the electronically calculated height is presented as a reliable data in the tests on explosiveness (Balsalobre-Fernández, C., et all, 2014, Glatthorn, J. F., et all., 2011). Furthermore, in this research, the significance of the correlation between standard methods for assessment of explosiveness (Abalak and standing long jump) and the electronic, with assistance of photocells, has shown that optojump is maximally competitive. These arguments are also complemented with the fact that electronic testing provides additional data which can be used while defining the explosive capacities of the examinees.

The multiple regression analysis, as predictor variables, takes the output data of testing with optojump, for contact time with surface (T.Cont), flight time (T.Flight), and Power as output from the jumps. These variables were chosen due to the fact that the results being generated are approximately dependent on the ultimate effect for presenting the explosiveness of legs. 3 multiple regression analyses were performed with dependent variables Height, SKOKVIS, SKOKDAL.

For the first multiple regression analysis, where 'height' is the dependent variable, the entire system of predictor variables significantly contributes to the analysis, in statistical terms, (R=0.99, p=0.000). The variables T.Cont and T.Flight are, in fact, the carriers of significance of the predictor system. The 'power' variable has no statistically significant participation in the system prediction. In cases when 'SKOKVIS' is the dependent variable, the system of predictor variables again impacts the analysis with statistical significance (R=0,519, p=0.017). In this case, the variable T.Flight has the single contribution in terms of significance (p=0.017). In the third multiple regression for the dependent variable 'SKOKDAL', the analysis is statistically significant (p=0.007) and once again, the leading (single) significance variable is T.Flight (p=0.03). The obtained data from the multiple regression analysis have indicated that the selected predictor variables 'T.Contact' and 'Power' cannot be used as predictors for the dependent variables 'SKOKVIS' and 'SKOKDAL'. The analysis, when 'Height' is the dependent variable, was performed for (one type of) control of the software of the optojump apparatus. However, the research has shown in this analysis that the data on muscle power of the examinees cannot be used (during testing of explosiveness of legs) as parallel indicators for performance assessment in vertical jump and standing long jump.

*Table No. 2,3,4. Multiple regression analysis*

| Dependent Variable: Height | | | | | |
|---|---|---|---|---|---|
| Model | R | R² | Adjusted R² | S.E.e | Sig. |
| | 0.999 | 0.998 | 0.998 | 0.199 | 0.000 |
| Independet | B | Std. Error | Beta | t | Sig. |
| (Constant) | -30.818 | 0.491 | | -62.809 | 0.000 |
| T.Cont | 2.531 | 1.095 | 0.032 | 2.311 | 0.027 |
| T.Flight | 121.493 | 1.777 | 0.991 | 68.384 | 0.000 |
| Power | 0.006 | 0.012 | 0.009 | 0.489 | 0.628 |
| Dependent Variable: SKOKVIS | | | | | |
| Model | R | R² | Adjusted R² | S.E.e | Sig. |
| | 0.519 | 0.270 | 0.201 | 6.712 | 0.017 |
| Independet | B | Std. Error | Beta | t | Sig. |
| (Constant) | 2.181 | 16.531 | | 0.132 | 0.896 |
| T.Cont | -56.511 | 36.904 | -0.408 | -1.531 | 0.136 |
| T.Flight | 164.573 | 59.857 | 0.775 | 2.749 | 0.010 |
| Power | -0.519 | 0.412 | -0.433 | -1.257 | 0.218 |
| Dependent Variable: SKOKDAL | | | | | |
| Model | R | R² | Adjusted R² | S.E.e | Sig. |
| | 0.559 | 0.312 | 0.248 | 15.210 | 0.007 |
| Independet | B | Std. Error | Beta | t | Sig. |
| (Constant) | 97.122 | 37.464 | | 2.592 | 0.014 |
| T.Cont | -51.908 | 83.635 | -0.161 | -0.621 | 0.539 |
| T.Flight | 301.528 | 135.653 | 0.608 | 2.223 | 0.033 |
| Power | -0.212 | 0.935 | -0.076 | -0.226 | 0.822 |

## Conclusion

Existence of correlation between the three included tests in this research has shown that, in method-related terms, tests are efficient when assessing the explosive strength of legs due to the fact that they approximately identically describe the ability being assessed. These data are similar to the research of Markovic G. 2004 However, in similar studies, the correlation between vertical jumps tests is not presented at a satisfactory level. Similar analysis (Bui, H. T et all, 2015, in which 3 tests were compared (optical system, contact mat, and Sargent jump), has shown that there is no correlation between the electronic devices and the Sargent jump test. Aragón, L. F. (2000) compares 4 tests and shows that even though there is validity between tests, the height values in all tests still differ in statistical terms. In addition, Leard, J. S., et all (2007), recognizing the difference in the obtained data of such type of research, include a 3D camera to compare the applied tests. Presumably, it can be recommended that those who shall apply the tests for explosive strength in legs shall have to choose the test they shall systematically apply, so as to show whether there are any changes of this ability following a treatment with exercises. Or, in case of transversal research, test-methods should be applied which shall be most efficient in terms of their application. It should be taken into consideration that new technologies provide an opportunity for collecting of a greater number of information in a single test, and their respective use in the analysis of the subject's capacities. Nevertheless, the authors are to decide on the application of a test which shall be most pragmatic for them; obviously, with verified metric properties.

Since we failed to find similar research on predictive analysis of values of the types contact time, flight time, and power, on the standing vertical jump and the standing long jump (as criteria), we can only conclude that, perhaps the time spent in the flight phase can in some way be used as a predictor on the reached height, during the testing of the standing vertical jump and the standing long jump. However, it applies in case of available optic technology, for testing of the explosive ability

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