

## DIFFERENCES IN TEST RESULTS OF THE EXPLOSIVE POWER EVALUATION OF HIGH SCHOOL STUDENTS THROUGHOUT THE ACADEMIC YEAR

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### Abstract

*In this research it was our goal to determine the differences between test results of the explosive power evaluation of first and second grade students during one academic year. It is common in school practice to use this exercise to estimate explosive power with – long jump from place. After analyzing and evaluating the results, we have determined whether the students results show progress, what is the range of results and their relationship to the proposed standards. The results of this study will help us to select students, guide students towards certain sports fields, and help teachers establish guidelines for selecting optimal methods of work and kinesiology operators to influence the development of certain motor skills.*

**Key words:** explosive power, test, results, motor skill

### Introduction

Explosive power is the ability that allows an athlete maximum acceleration of his own body, or an object or a partner in the activities such as toss and dersh, jumps, kicks and sprint (Milanović, 2004). It belongs to a group of quantitative motor skills that allow a high level of intensity and extensity of its work making thus its development a very important factor in achieving results in many sports fields. Motor skills do not have identical hereditary factor, skills like speed, coordination, and explosive power are much more inherited than repetitive skills such as static strength and flexibility. Those capabilities that have higher hereditary factor need to be developed from early infancy and childhood because their development also ends earlier, while abilities that are less innate should also be developed from early youth, but their development is possible to be influenced throughout life (Findak, 2001). In school practice within the physical education practice is applied test for the assessment of explosive power – long jump from place. Testing is carried out through three periods during one school year, at the beginning of the school year as an initial check, during the school year as a transitive checking and at the end of the school year as a final testing. Through checking during certain time periods we obtain an insight into the level and quality of explosive power test that are essential within the battery of tests of motor skills that are applied in practice. Based on the results of motor and functional abilities, teachers of physical education outline a program with the goal to improve the level of skills and contribute to better results in the coming period. Based on the obtained results, teachers classify students into homogenized groups and influence using kinesiology operators the development of different motor skills. There are a variety of exercises to develop explosive power to be used in practice. The system of training includes plyometric training – training method that should be used in conjunction with

other methods of strengthening within the overall training program to improve the relationship between maximal strength and explosive power. Plyometric is a name for each type of training in which is present eccentric-concentric muscular work (Antekolović et al., 2001). In order to be effective, methods of exercise should be performed technically correct, with gradually increasing load and the application of periodization (Gambetta, 1989). Verhoshansky has been experimenting with different types of plyometric in relation to the improvement of explosive power. His experiments led to a conclusion that there is an improvement in overall neuromuscular system and the speed of contraction (Bompa, 1993).

### Problem and aim

The main objective of this paper is to define the differences in the results of the explosive power evaluation test in the annual cycle. These results will help us in the selection of students, guiding students towards certain sports fields, and will serve to teachers as a response whether we have applied the proper methods and kinesiology operators to influence the development of certain motor skills.

### Methods

#### *The sample of examinees*

The study was conducted on a sample of 70 students, of which 33 girls and 37 boys. All examinees were students from Vrbovec High School, between fifteen and sixteen years of age, and medically fit for the attendance of physical education. Students involved in the study attended first and second grades of vocational guidance (economists, traders, cooks, waiters, butchers).

#### *Pattern variables*

For the purposes of this study were carried out two measurements. The first sample was measured at the beginning of the school year 2011/2012., second sample at the beginning of the school year 2012/2013., and also were taken

into account the initial probation results (Overview of physical and health education of the school year 2011/2012., and Overview of physical education 2012/2013.). Testing was conducted in accordance with the measurement requirements prescribed in *Applied Kinesiology in Education* (Norms) (Findak, Metikoš, Mraković & Neljak, 1996). Research included a variable to assess explosive power (MSD – long jump from place).

**Methods of data processing**

For statistical analysis of the data was used program package *Statistics for Windows 5.0*. Results analysis calculated basic statistical parameters: mean (Mean), minimum (Min) and maximum value (Max), standard deviation (Std. Dev.), evaluation of the results according to the proposed standards (Norms) where descriptive marks are shown in the table as poor, below average, average, above average and excellent and t-test for dependent patterns.

**Results and discussion**

Table 1 Descriptive statistical parameters of first grade students

Variable	N	Mean	Min	Max	Std. Dev.	Norms (Findak et al., 1996).
VAR1	37	203,14	130,00	245,00	25,17	Below Average

Variable – variable, Valid N – number of examinees, Mean – mean, Min – minimum, Max – maximum, Std. Dev. – standard deviation, Norms – norms

Table 2 Analysis of the results of the first grade students

Obtained results (cm)	Frequencies (number of students)	Norms (Findak et al., 1996).
130	1	Poor
160-170	2	Poor
170-180	5	Poor
180-190	3	Poor
190-200	4	Below Average
200-210	8	Average
210-220	8	Average
220-230	1	Above Average
230-240	3	Excellent
240-250	2	Excellent

Comparison of test results for the assessment of explosive power (MSD – long jump from place) obtained in two time periods reveal significant difference in the results. Calculating descriptive statistical parameters, we came to the conclusion that the examinees (students) made progress in test scores. The arithmetic mean of the results of the first grade students is 203,14 cm (Table 1), while the arithmetic mean of the same students in the second grade is 210,22 cm (Table 3). The standard deviation of the first grade students is 25,17 (Table 1.), while the standard deviation of the same students in the second grade is 27,44 (Table 3.). The range between the minimum and maximum result of first-grade students was 115 cm, the worst result being 130 cm, while the highest score is 245 cm (Table 1). The range

between the minimum and maximum result of the same students in their second grade is higher than in the first grade and equals 125 cm. Lowest score is 130 cm, while the highest score is 255 cm (Table 3). These obtained results compared with the norms stating the guiding values for long jump from place for students of the first grade of high school students score them below average (Table 1), while the result of the same students in the second grade score their results as average (Table 3) (Findak, Metikoš, Mraković, Neljak, 1996). By analyzing the individual results of the test of explosive power we have noticed progress in individual student scores in their second grade (Table 4), in comparison to students of the first grade (Table 2). The histogram also shows greater homogeneity of results in the second grade (Figure 2) compared to the results of the test in the first year (Figure 1).

Table 3 Descriptive statistical parameters of second grade students

Variable	N	Mean	Min	Max	Std. Dev.	Norms (Findak et al., 1996).
VAR2	37	210,22	130,00	255,00	27,44	Average

Variable – variable, Valid N – number of examinees, Mean – mean, Min – minimum, Max – maximum, Std. Dev. – standard deviation, Norms – norms

Table 4 Analysis of the results of second grade male students

Obtained result (cm)	Frequencies (number of students)	Norms (Findak et al., 1996).
130	1	Poor
150-160	1	Poor
160-170	1	Poor
170-180	2	Poor
180-190	4	Poor
190-200	4	Below Average
200-210	5	Below Average
210-220	6	Average
220-230	3	Above Average
230-240	7	Above Average
240-250	2	Excellent
250-260	1	Excellent

Table 5 Descriptive statistical parameters of first grade female students

Variable	N	Mean	Min	Max	Std. Dev.	Norms (Findak et al., 1996).
VAR3	33	165,82	110,00	220,00	27,19	Below Average

Variable – variable, Valid N – number of examinees, Mean – mean, Min – minimum, Max – maximum, Std. Dev. – standard deviation, Norms – norms

T-test for dependent pattern (Table 9.) showed that there is a statistically significant difference between the results of the examinees (students) in the two time points (annual cycle) at a significance level of 0.05 (p < 0.05) (Petz, 1985 ). Calculating descriptive statistical parameters of the explosive power test for female students we have also noticed progress in results in second grade compared to previous year.

Table 6 Analysis of the results of the first grade female students

Obtained result (cm)	Frequencies (number of students)	Norms (Findak et al., 1996).
110	1	Poor
110-120	2	Poor
140-150	6	Poor
150-160	6	Poor
160-170	7	Below Average
170-180	4	Average
190-200	2	Excellent
200-210	3	Excellent
210-220	2	Excellent

Table 8 Analysis of the results of second grade male students

Obtained result (cm)	Frequencies (number of students)	Norms (Findak et al., 1996).
110	1	Poor
110-120	1	Poor
120-130	1	Poor
140-150	4	Poor
150-160	5	Poor
160-170	8	Poor
170-180	4	Below Average
180-190	1	Average
190-200	1	Above Average
200-210	5	Excellent
210-220	2	Excellent

Table 7 Descriptive statistical parameters of second grade female students

Variable	N	Mean	Min	Max	Std. Dev.	Norms (Findak et al., 1996).
VAR4	33	171,27	110,00	220,00	27,47	Below Average

Variable – variable, Valid N – number of examinees, Mean – mean, Min – minimum, Max – maximum, Std. Dev. – standard deviation, Norms – norms

The arithmetic mean of the results of female students in the first class is 165,82 cm (Table 5), while the arithmetic mean of the results in the second grade is 171,27 cm (Table 7). The standard deviation of the results of female students in the first class is 27,19 (Table 5), while the standard deviation of the female students in the second grade is 27,47 (Table 7).

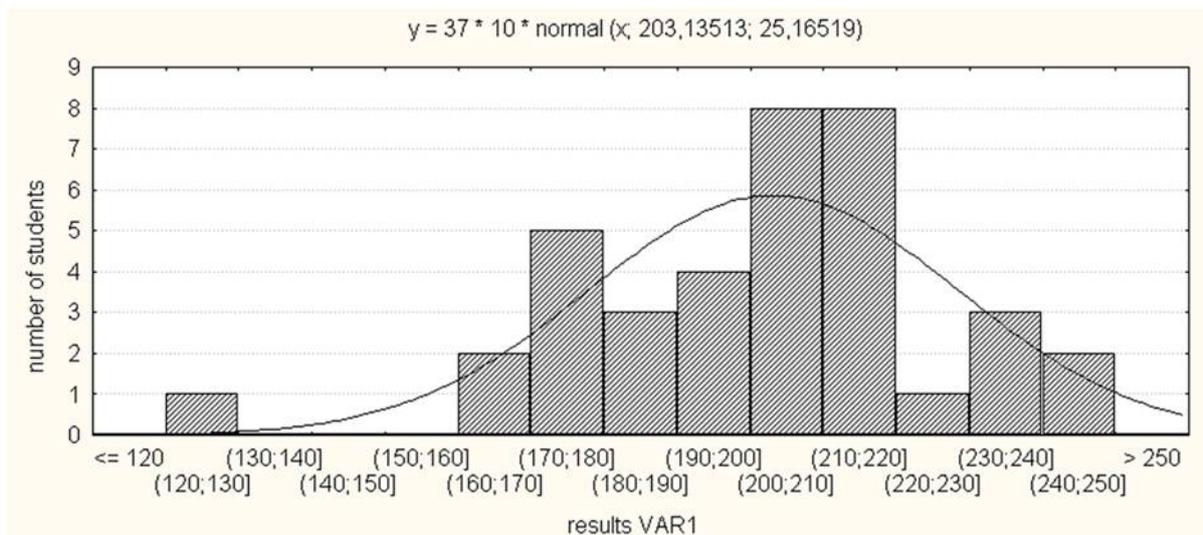
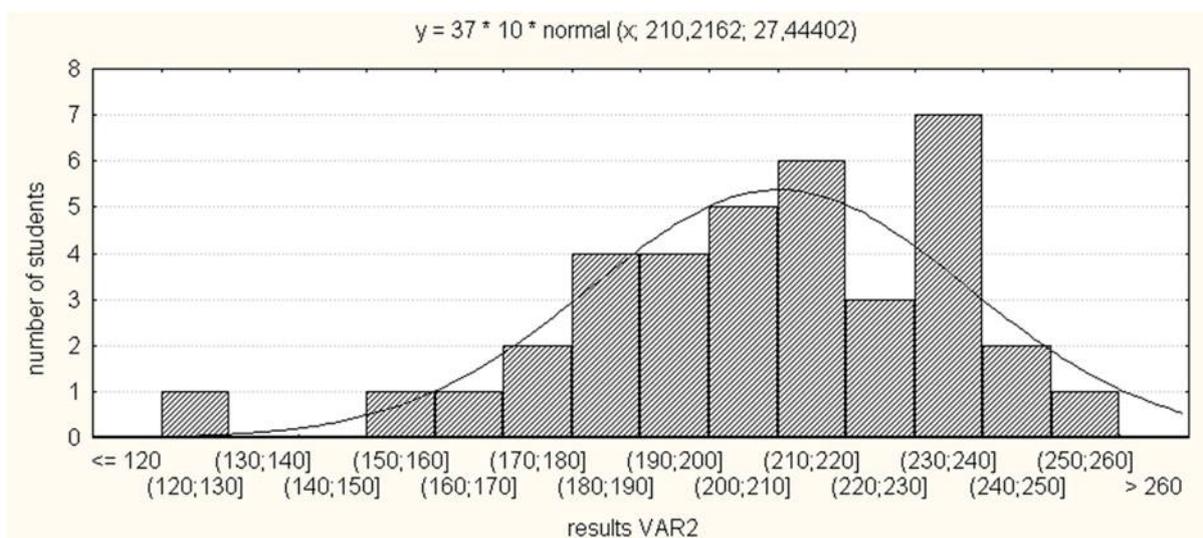
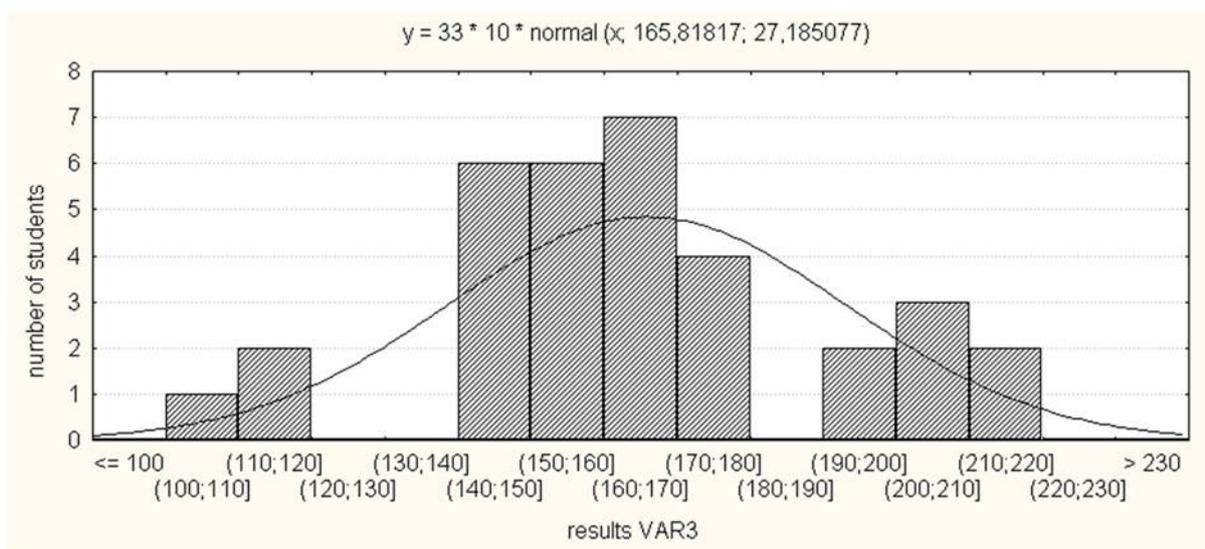


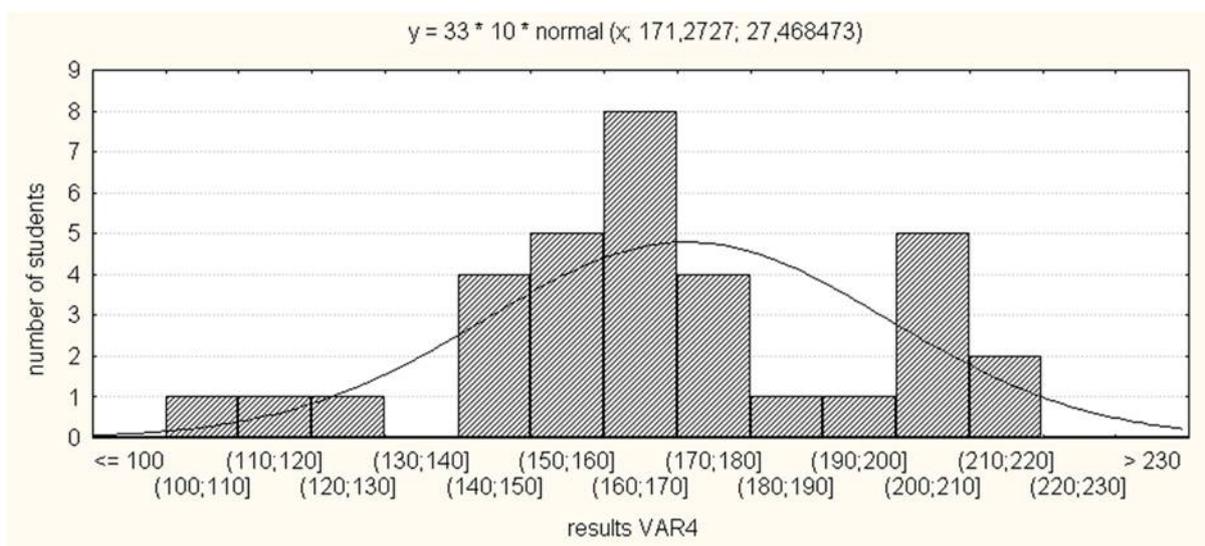
Figure 1 Presentation of results made by first grade students



Graph 2 Presentation of the results of second grade male students



Graph 3 Presentation of the results made by first grade female students



Graph 4 Presentation of the results of second grade female students

Table 9 Descriptive statistical parameters of male students and t-test for dependent patterns

Variable	Mean	Std. Dev.	N	t	p
VAR1	203,14	25,17			
VAR2	210,22	27,44	37	-3,13	,003

Variable – variable, Mean – mean, Std. Dev. – standard deviation, N – number of examinees, t-test, p – level of relevance

Table 10 Descriptive statistical parameters of female students and t-test for dependent patterns

Variable	Mean	Std. Dev.	N	t	p
VAR3	165,82	27,19			
VAR4	171,27	27,47	33	-3,09	,004

Variable – variable, Mean – mean, Std. Dev. – standard deviation, N – number of examinees, t-test, p – level of relevance

The range between the minimum and maximum possible score in first and second class equals 110 cm. Minimum and maximum results in both classes are equal, the worst result being 110 cm and highest score being 220 cm (Table 5 & 7).

A larger number of female students has achieved above average and excellent results compared to norms stated in the guiding values for the long jump from place (Findak, Metikoš, Mraković & Neljak, 1996), which ultimately led to the improvement in test scores. Results of the long jump from place for the first year high school students score below average compared to norm (Table 5), while the result of the same student score also below average in the second grade (Table 7) (Findak, Metikoš, Mraković & Neljak, 1996).

Analysis of test results shows the explosive power of the individual students and differences in the results in the second grade (Table 8) compared to students in the first year (Table 6). T-test for dependent patterns (Table 10.) showed that there is a statistically significant difference between the results of the examinees (students) at two time points (annual cycle) at a significance level of 0.05 ( $p < 0.05$ ) (Petz, 1985).

**Conclusion**

Calculating descriptive statistical parameters and t-test for dependent patterns showed statistically significant differences in the results of the test of explosive power male and female students at two time points (annual cycle) at a significance level of 0.05 ( $p < 0.05$ ) (Petz, 1985). Significant progress is obtained in young students; in the first grade scores were below average compared to the guiding values of the long jump from place leaving only six students with above average and excellent ratings, while in the second grade class rating norms were average compared to the guiding values of the long jump from place and thirteen boys scored above average and excellent results (Findak, Metikoš, Mraković, Neljak, 1996). Young female students have also made progress in the results of the test to assess explosive power. Class norms compared to guiding values of long jump from place were below average (Findak, Metikoš, Mraković, Neljak, 1996). at both time points of measurement, but individual results show that most of the students achieved above average and excellent performance of the second year, which ultimately led to the improvement in test scores. Joint cooperation of teachers and students in physical education class, the proper use of the default motor tasks, students involvement in some sports activities within extracurricular activities or sports clubs all led to improvement in the results of the test of explosive power. Fifteen and sixteen year olds are in the second phase of rapid growth, which among other things is characterized by bone growth in length, increased muscle mass relative to subcutaneous fat which is also impacted (Findak, 2001).

Various motor tasks aiming to improve explosive power can be applied to all parts of physical education class, in the introductory part of the lesson in the form of individual elementary games, in the preliminary part of the lesson in the form of strength training, and strengthening leg and trunk muscles; in the main "A" part of the lesson classifying students in groups and homogenized

using the drop jump and various exercises who led to development of explosive strength, that was mentioned by many authors (Chu, 1992)., (Zatciorsky, 1995)., (Čoh, 2004)., and whose implementation is carried out with medical ball and is related to strength, speed, endurance, precision, explosiveness through throwing, catching and kicking (Lorette, L. H. 1985)., in the main "B" part of the lesson using a variety of sports games, and in the final part of class by application of elementary games or exercising static stretching of individual muscle groups. Volume and dosage are usually associated with the type, complexity and intensity of exercises. Amount of work to be aligned with the planned phases of training, progression and achieved levels of development (Radcliffe and Farentinos, 2003). Dosage is planned in accordance with the continuity of progress, according to the intensity and complexity of the exercise. Method that is suitable for the development of explosive power is a method by which explosive stimuli with 50 – 60 % of the external load perform fast repetitions, with the activation of certain muscle groups (Milanović, 1997). By implementing we should respect the principle of intention, which means that plyometric training should be based on the specific relations between the objectives to be achieved and a training program that should ensure the achievement of the desired goals (Birkić, 2003). Chronological age has an important role in choosing exercises for developing explosive power. Maturity or immaturity of the nervous system and skeletal system affect the tolerance of plyometric training. Young athletes, who have not yet entered puberty, should not work at all plyometrics, particularly one of intensive stage. Therefore, working with children, adolescents and preadolescents we should be careful in choosing the method of work as well as in the selection of motor tasks and dosage volume loads. Only in this way we will properly influence the transformation process and a positive impact on the anthropological status of students.

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## RAZLIKE U REZULTATIMA TESTA ZA PROCJENU EKSPLOZIVNE SNAGE UČENIKA SREDNJE ŠKOLE U GODIŠNJEM CIKLUSU

### Sažetak

Ovim istraživanjem željeli smo utvrditi razlike u rezultatima testa za procjenu eksplozivne snage učenika prvih i drugih razreda srednje škole u godišnjem ciklusu. U školskoj praksi primjenjuje se test za procjenu eksplozivne snage – skok u dalj s mjesta. Analizom i obradom rezultata utvrdili smo jesu li učenici napredovali u rezultatima, kakav je odnos između rezultata učenika te kakve su ocjene rezultata testa za procjenu eksplozivne snage u odnosu na predložene norme. Rezultati istraživanja pomoći će nam u selekcioniranju učenika, usmjeravanju učenika prema određenim sportskim granama, a pomoću njih će i nastavnici odrediti smjernice za odabirom optimalnih metoda rada i kinezioloških operatora kako bi utjecali na razvoj određenih motoričkih sposobnosti.

**Ključne riječi:** eksplozivna snaga, test, rezultati, motoričke sposobnosti

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