**DIFFERENCES IN THE EXPLOSIVE JUMPING STRENGTH OF**

**DIFFERENT GENERATIONS OF FEMALE STUDENTS AT THE**

**FACULTY OF KINESIOLOGY**

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**Abstract**

Assessment of differences in explosive jumping strength was carried out in the form of the standing long jump test (SLJ) on a sample of 416 first-year students enrolled in regular studies at the Faculty of Kinesiology of the University of Zagreb. Measuring was carried out as part of regular classes in the subject Basic Kinesiological Transformations for female students with the aim of establishing differences of various generations, and differences between students who studied according to the "old" curriculum and those studying according to the Bologna curriculum. The results were processed by descriptive analysis, the t-test for equality of means and ANOVA. The results show that in all parameters observed there are statistically significant differences in favour of those generations of students who studied according to the "old" curriculum in comparison to those studying according to the Bologna curriculum.

***Key words:*** *female**students, study programmes, explosive strength, standing long jump*

**Introduction**

Explosive jumping strength is one of the key biomotor abilities in almost all conventional kinesiological activities, and one of the determinants of success in activities requiring the ability to produce maximum muscle force in the shortest possible period (Newton and Kreamer, 1994). The amount of explosive strength is determined by the ability of the summary utilisation of a large number of muscle groups that are involved in the movement, the criterion of complete inter- and intra-muscular coordination and the most favourable ratio between the components of speed and power. The aim of this research was to establish whether there are any statistically significant differences between students of various generations in the first year of study at the Faculty of Kinesiology in the initial and final jumps in the standing long jump test (SLJ) (Metikoš et al., 1989), and whether there are any statistically significant differences between the generations of students who studied according to the "old" curriculum and the generations of students studying according to the Bologna curriculum.

Students who studied according to the "old" curriculum had up to 20% more classes in certain theoretical-practical subjects during their regular studies, which is one of the presumptions for the expected greater level of motor skills, in this case explosive jumping strength. With work in smaller groups, the Bologna curriculum leads to more efficient work in classes, and with the continuous monitoring and testing of the level of skills and knowledge acquired by means of intra-term exams, the better engagement of students is ensured during the semester/year.

Explosive jumping strength is a frequent subject of research and study. Most authors in their research establish differences and the mutual impact of explosive strength and other motor skills in various activities, sports and sport disciplines (Jared et al., 2010, Erčulj et al., 2009, Vuleta et al., 2010, Ručević et al., 2010). There is a considerably smaller number of authors who have carried out research on a population of students by examining factors that influence the standing long jump test and the connectedness of muscles important for improving explosive jumping strength (Radoš et al., 2010, Ivančević, 1998)).

**Methods**

This research included six generations in total, that is, 416 students in the first year of regular studies at the Faculty of Kinesiology, University of Zagreb, where the chronological age of the examinees was 19±1 years. Some 207 students (average body height, ATV = 168.93±1.16 cm; body mass, ATT = 60.51±0.52 kg) studied according to the "old" curriculum, and 209 (ATV = 168.45±1.5 cm; ATT = 60,57±0.51 kg) are studying according to the new Bologna curriculum.

An assessment of explosive jumping strength was carried out by the standing long jump test (SLJ) on two occasions, at the initial measurement in October, at the beginning of the academic year (which is a reflection of the level of skills and work prior to enrolment), and the final measurement (expected progress as a result of work during the first year of studies in practical subjects and as a result of preparations for intra-term and final exams) in May, at the end of the current academic year.

Data were processed by the statistical software package Statistica 7.0.61.v. Using the Kolmogorov-Smirnovljev test, it was established that the results of the initial and final measurements of the individual generations do not deviate significantly from the normal distribution, and further processing of the results proceeded by descriptive analysis.

With the t-test for dependent samples, it was determined if there were statistically significant differences in the initial and final measurements between individual generations: arithmetic mean (AM), standard deviation (SD), number of students (N), difference (DIFF), standard deviation of differences (SD. DIFF), t-value (t), error (p), degrees of freedom (df).

The difference between the generations in the initial and final measurements of the standing long jump test was tested by the univariate analysis of variance – ANOVA.

**Results**

*Tablica 1. Deskriptivni parametri inicijalnog (SDM-I) i finalnog (SDM-F) mjerenja studentica "starih" generacija*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **"old" generations** | | **N** | **mean** | **MIN** | **MAX** | **SD** |
| **2002-03** | SDM-I | 69 | 198,18 | 152,67 | 237,67 | 16,06 |
| SDM-F | 69 | 209,90 | 173,33 | 241,67 | 12,5 |
| **2003-04** | SDM-I | 58 | 201,11 | 177,67 | 236 | 14,02 |
| SDM-F | 58 | 211,82 | 187 | 251,67 | 14,54 |
| **2004-05** | SDM-I | 80 | 203,08 | 180 | 240 | 14,00 |
| SDM-F | 80 | 214,30 | 188,33 | 267,33 | 13,71 |

*Tablica 2. Deskriptivni parametri inicijalnog (SDM-I) i finalnog (SDM-F) mjerenja studentica generacija "Bolonje":*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **generations "Bolonje"** | | **N** | **mean** | **MIN** | **MAX** | **SD** |
| **2005-06** | SDM-I | 74 | 194,39 | 158 | 235 | 16,51 |
| SDM-F | 74 | 206,30 | 171,67 | 250 | 15,11 |
| **2006-07** | SDM-I | 74 | 195,05 | 151,67 | 231,67 | 13,93 |
| SDM-F | 74 | 208,76 | 180 | 241,67 | 13,30 |
| **2007-08** | SDM-I | 61 | 194,19 | 165,33 | 232,33 | 12,46 |
| SDM-F | 61 | 207,30 | 144,67 | 248 | 15,41 |

Osnovni statistički parametri u inicijalnom i finalnom mjerenju, ukazuju da vrijednosti aritmetičkih sredina u svim generacijama imaju tendenciju poboljšanja rezultata (najmanje u generaciji 2003/04 za 10.71 cm, a najviše u generaciji 2006/07 za 13.71 cm). Vrijednosti standardnih devijacija raspršenosti dobivenih rezultata variraju više u inicijalnim provjeravanjima dok su u finalnim mjerenjima rezultati ujednačeniji što ukazuje na usvojenost pravilne tehnike izvođenja promatranog motoričkog zadatka.

Napredak između inicijalnih i finalnih provjeravanja je za 1.65 cm veći u korist studentice „Bolonje“ (12,9 cm) od napretka studentica „starog“ plana i programa (11,25 cm).

*Tablica 3. T – test for dependent samples pojedinih generacija*

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | variables | T-test for Dependent Samples  Marked differences are significant at p< ,05000 | | | | | | | |
| mean | Std.Dv. | N | Diff. | Std.Dv.Diff. | t | df | p |
| **2002-03** | MEAN SDM-I | 198,18 | 16,05989 |  |  |  |  |  |  |
| MEAN SDM-F | 209,90 | 12,4974 | 69 | -11,7246 | 6,9712 | -13,9706 | 68 | 0,0000 |
| **2003-04** | MEAN SDM-I | 201,11 | 14,0247 |  |  |  |  |  |  |
| MEAN SDM-F | 211,82 | 14,5374 | 58 | -10,7069 | 8,2064 | -9,9363 | 57 | 0,0000 |
| **2004-05** | MEAN SDM-I | 203,08 | 13,9948 |  |  |  |  |  |  |
| MEAN SDM-F | 214,30 | 13,7129 | 80 | -11,7246 | 6,9712 | -13,9706 | 68 | 0,0000 |
|  | | | | | | | | | |
| **2005-06** | MEAN SDM-I | 194,39 | 16,5106 |  |  |  |  |  |  |
| MEAN SDM-F | 206,30 | 15,1051 | 74 | -11,9099 | 9,8411 | -10,4107 | 73 | 0,0000 |
| **2006-07** | MEAN SDM-I | 195,05 | 13,9330 |  |  |  |  |  |  |
| MEAN SDM-F | 208,76 | 13,2992 | 74 | -13,7117 | 8,1626 | -14,4504 | 73 | 0,0000 |
| **2007-08** | MEAN SDM-I | 194,19 | 12,4696 |  |  |  |  |  |  |
| MEAN SDM-F | 207,30 | 15,4147 | 61 | -13,1202 | 13,3236 | -7,6910 | 60 | 0,0000 |

*Tablica 4. T – test razlika između generacija različitih programa studija*

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | variables | T-test for Dependent Samples  Marked differences are significant at p< ,05000 | | | | | | | |
| mean | Std.Dv. | N | Diff. | Std.Dv.Diff. | t | df | p |
| **"old" program** | MEAN SDM-I | 200,89 | 14,7990 |  |  |  |  |  |  |
| MEAN SDM-F | 212,14 | 13,6259 | 207 | -11,2448 | 7,7391 | -20,9048 | 206 | 0,0000 |
| **Bologna** | MEAN SDM-I | 194,56 | 14,4497 |  |  |  |  |  |  |
| MEAN SDM-F | 207,46 | 14,5528 | 209 | -12,9011 | 10,4488 | -17,8498 | 208 | 0,0000 |

T-testom razlika na razini značajnosti p<0.00 između inicijalnih i u finalnih mjerenja utvrđena je statistička značajna razlika unutar generacija po "starom" programu studija, kao i između generacija po programu studija "Bolonje"

*Tablica 5. Analiza varijance između različitih generacija*

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Variable | Analysis of Variance  Marked effects are significant at p < ,05000 | | | | | | | |
| SS  Effect | Df  Effect | MS  Effect | SS  Error | df  Error | MS  Error | F | p |
| MEAN SDM-I | 4168,019 | 1 | 4168,019 | 88545,08 | 414 | 213,8770 | 19,48792 | 0,000013 |
| MEAN SDM-F | 2272,321 | 1 | 2272,321 | 82297,79 | 414 | 198,7869 | 11,43094 | 0,000791 |

*Tablica 6. Post Hoc Sheffe test za rezultate inicijalnog mjerenja*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Scheffe test; variable MEAN SDM – I  Probabilities for Post Hoc Tests  Error: between MS = 213,72, df = 410,00 | | | | | |
| {1}  198.18 | {2}  201.11 | {3}  203.08 | {4}  194.39 | {5}  195.05 | {6}  194.19 |
| 2002-03 |  | 0.9381 | 0.5271 | 0.7909 | 0.8965 | 0.7889 |
| 2003-04 | 0.9381 |  | 0.9874 | 0.2326 | 0.3504 | 0.2489 |
| 2004-05 | 0.5271 | 0.9874 |  | 0.0198 | 0.0427 | 0.0268 |
| 2005-06 | 0.7909 | 0.2326 | 0.0198 |  | 0.9999 | 1.0000 |
| 2006-07 | 0.8965 | 0.3504 | 0.0427 | 0.9999 |  | 0.9997 |
| 2007-08 | 0.7889 | 0.2489 | 0.0268 | 1.0000 | 0.9997 |  |

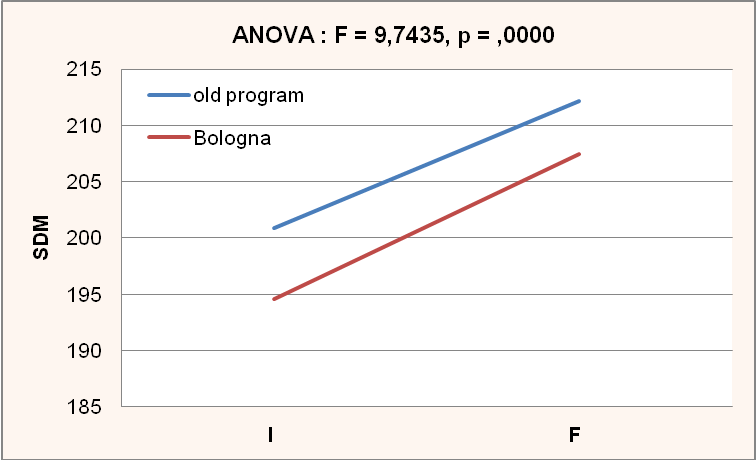
Post Hoc Sheffe test potvrdio je statistički značajnu razliku između 3. generacije "starog" programa i svih generacija novog programa u rezultatima inicijalnog mjerenja.

*Tablica 7. Post Hoc Sheffe test za rezultate finalnog mjerenja*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Scheffe test; variable MEAN SDM – F  Probabilities for Post Hoc Tests  Error: between MS = 198.41, df = 410,00 | | | | | |
| {1}  198.18 | {2}  201.11 | {3}  203.08 | {4}  194.39 | {5}  195.05 | {6}  194.19 |
| 2002-03 |  | 0.9888 | 0.6073 | 0.8000 | 0.9987 | 0.9538 |
| 2003-04 | 0.9888 |  | 0.9586 | 0.4184 | 0.9093 | 0.6926 |
| 2004-05 | 0.6073 | 0.9586 |  | 0.0313 | 0.3138 | 0.1319 |
| 2005-06 | 0.8000 | 0.4184 | 0.0313 |  | 0.9509 | 0.9994 |
| 2006-07 | 0.9987 | 0.9093 | 0.3138 | 0.9509 |  | 0.9964 |
| 2007-08 | 0.9538 | 0.6926 | 0.1319 | 0.9994 | 0.9964 |  |

Dodatno, u rezultatima finalnog mjerenja, Post Hoc Sheffe test ukazao je na statistički značajnu razliku između 3. generacije "starog" programa i prve generacije Bolonjskog programa.

*Graf 1.* *Razlike u napretku studentica prema "starom" i novom programu "Bolonje".*



Dobiveni rezultati analize varijance u inicijalnom i finalnom provjeravanju statistički su značajne na razini značajnosti p<0,01 u korist generacija studentica „starog“ plana i programa prema studenticama plana i programa "Bolonje", što potvrđuje i grafički prikaz.

**Discussion and Conclusions**

With the aim of determining differences in the explosive jumping strength of female students who studied according to the "old" curriculum and female students studying according to the Bologna curriculum using the standing long jump test, 416 students (6 generations) in the first year of study at the Faculty of Kinesiology of the University of Zagreb were taken as sample examinees for this research.

An analysis of the basic morphological variables (the average body height ATV of the "old" generation = 168.93±1.16 cm and the body mass ATT of the "old" generation = 60.51±0.52 kg; ATV of the Bologna generation = 168.45±1.5 cm; ATT of the Bologna generation = 60.57±0.51 kg) showed no significant differences between the generations concerned, so we may conclude that they have no impact on the results achieved.

Descriptive processing of the basic statistical indicators based on arithmetic means shows that the results of the initial and final measurements have a tendency to raise the results, indicating progress in all generations. Based on the gathered values of standard deviations, the dispersion of results varies mostly in the initial measuring, while the results are more uniform in the final measurement, which shows that the proper technique of performing the motor task was learned.

The t – test for equality of means confirmed the statistical significance of the difference in the initial and final jumps of all generations examined, and between the three generations according to the "old" curriculum and the Bologna curriculum. The analysis of variance showed that there was a statistically significant difference between the generations of students examined in favour of those students who studied according to the "old" curriculum.

There is a whole series of factors which have an impact on success in carrying out a particular task. This research aimed to establish whether the different curricula at the Faculty of Kinesiology have any influence on the difference in the results of the standing long jump test in the initial and final measurements. The students who studied according to the "old" curriculum had up to 20% more practical classes in certain theoretical-practical subjects, and thus as expected better motor skills. Work in smaller groups according to the Bologna curriculum leads to more efficient work in classes, and systematic exercising which is subject to continued monitoring and testing of the level of motor skills and knowledge acquired in the form of intra-term exams throughout the year, leads to the somewhat greater progress of 1.65 cm in favour of the generations concerned.

Research showed that the level of explosive jumping strength of the female students of the Faculty of Kinesiology depends significantly on the curriculum, but a large number of other factors has a significant impact on the total level of their skills, such as the level of motor skills and knowledge of the students at the time of enrolment (it is worrying that the results of the Bologna students in the initial measurement are deteriorating), and the declining number of female students actively involved in various sporting activities, either in professional sports and/or recreation, etc., resulting in the increasingly poor motor skills of new generations of students.

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