INTRODUCTION

In precious publications we have analyzed the individual power and speed differences during competitive and additional exercises of elite men and women power lifters. The results have shown the need for a more detailed interpretation of individual qualities in men and women. On this basis, we have analyzed the condition and relationships between competitive and basic exercises in men power lifters. Another reason for this analysis was that the specialized literature gives only general recommendations (Boyanov, & Kazaklis, 2010b); (Boyanov & Petrova, 2011a); (Boyanov & Petrova, 2011b); (Boyanov & Kapandzhiev, 2012). Such methods do not help with minimizing asymmetry in strength and speed development as well as the general development of the athlete. At the same time, we need to note that there are much more possibilities for growth in relatively less developed exercises, competitive or general. Last but not least is the fact that the relative equality of the above mentioned drills leads to symmetric morpho-functional development of muscle groups which in itself is a good prevention against injury.

Goals and tasks

We have made it our goal to establish an evaluation system for individual technical results in men power lifters. To reach this goal we have set the following tasks:

1. To analyze the results and relationships in competitive and basic drills in the best power lifters in Bulgaria.
2. To create models, measuring the level of mastery in competitive as well as basic drills.

METHODS

The object of the analysis were 94 men, active competitors during 2006. They were given a questionnaire on the following: 1. Age, 2. Years of training, 3. Weight (kg), 4. Height (cm), 5. Snatch (kg), 6. Clean and jerk (kg), 7. Snatch with squat (kg), 8. Chest lifting with squat (kg), 9. Squat with barbell on chest (kg). The recorded achievements were represented as the maximum reached in training conditions during the competitive stage of training.

The results were analyzed through variation, correlation and regression analysis as per the methodologies of Boyanov, & Kazaklis, 2010.

RESULTS AND DISCUSSION

The age of male athletes presupposes to a certain extent the years of training (R=0.64), although it is not related to the technical results. It is also valid for women athletes (R=0.59) (Boyanov & Bal-
At the same time, the years of training do influence the absolute results of the athletes (R from 0.342 to 0.405), while in women (Boyanov & Baladjieva, 2012), this relationship is more pronounced (R from 0.695 to 0.786). The influence of height are moderate (R from 0.457 to 0.516), while body weight influences results more strongly (R from 0.717 to 0.746) in men than in women (R from 0.611 to 0.667). The strong relationship between the height and weight (R = 0.723) in men shows the optimal established weight categories in comparison with women (R from 0.683) (Boyanov & Baladjieva, 2012).

The highest variability of the medium data of analyzed items are established for years of training (39.353%) and body weight (23.694). Less, but equivalent in deviation from the medium data are noticed for competitive (17.042-17.628%) and additional (16.388-19.657%) exercises. Such increased variability can be explained with the fact that athletes were grouped according to their age, not weight categories. In women athletes we established even higher dispersion around the medium values (7 Boyanov, & Baladjieva, 2012) and lower results in similar analyses for men and women.

It has to be noted that while the competitive exercise snatch is influenced by the preparatory exercise snatch with a squat (R=0.968), the clean and jerk favors barbell lifting to the chest with a squat (R=0.975) as a preparatory exercise as well as squat with barbell to the chest (R=0.954). This is confirmed by the received multiple numbers and curves in the regression equations with very high dispersion. Functional relations were found in the competitive exercise snatch as a function and arguments: snatch with squat, barbell lifting to the chest with a squat, squatting with the barbell to the chest and clean and jerk – 0.970 explained dispersion. For clean and jerk as a function and arguments: barbell lifting to the chest with a squat, squatting with barbell to the chest, snatch with a squat and snatch, the explained dispersion is 0.985.

The established functional relations between the competitive and preparatory exercises (R from 0.924 to 0.980) form a basis for interpolation with high reliability.

### Multiple regression men new

1.) \( Y = 14.14321 + 0.629006X1 + 0.337921X2; \) 0.952 explained dispersion; 

\[ Y = \text{snatch, } X1 = \text{snatch with squat, } X2 = \text{lifting to chest with squat} \]

2.) \( Y = 14.21028 + 0.629367X1 + 0.340051X2 – 0.00212X3; \) 0.952 explained dispersion; 

\[ Y = \text{snatch, } X1 = \text{snatch with squat, } X2 = \text{lifting to chest with squat, } X3 = \text{squat with barbell to chest} \]

3.) \( Y = 10.6474 + 0.720841X1 – 0.17286X2 – 0.00111X3 + 0.556471X4; \) 0.970 explained dispersion; 

\[ Y = \text{snatch, } X1 = \text{snatch with squat, } X2 = \text{lifting to chest with squat, } X3 = \text{squat with barbell to chest, } X4 = \text{clean and jerk} \]

### Table 1. Variation table of analyzed data for men athletes

<table>
<thead>
<tr>
<th>Items</th>
<th>Min</th>
<th>Max</th>
<th>R</th>
<th>X</th>
<th>S</th>
<th>V%</th>
<th>SE</th>
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</thead>
<tbody>
<tr>
<td>1. Age</td>
<td>20.5</td>
<td>33.0</td>
<td>12.6</td>
<td>25.9</td>
<td>3.3</td>
<td>12.6</td>
<td>0.4</td>
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<tr>
<td>2. Years of training</td>
<td>4.0</td>
<td>20.0</td>
<td>16.0</td>
<td>10.3</td>
<td>4.1</td>
<td>39.4</td>
<td>0.5</td>
</tr>
<tr>
<td>3. Height</td>
<td>153.0</td>
<td>195.0</td>
<td>42.0</td>
<td>172.0</td>
<td>7.7</td>
<td>4.5</td>
<td>1.0</td>
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<tr>
<td>4. Body weight</td>
<td>63.0</td>
<td>157.0</td>
<td>94.0</td>
<td>85.8</td>
<td>20.3</td>
<td>23.7</td>
<td>2.7</td>
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<tr>
<td>5. Snatch</td>
<td>105.0</td>
<td>205.0</td>
<td>100.0</td>
<td>153.5</td>
<td>7.7</td>
<td>4.5</td>
<td>1.0</td>
</tr>
<tr>
<td>6. Clean and Jerk</td>
<td>33.0</td>
<td>255.0</td>
<td>122.5</td>
<td>189.1</td>
<td>32.2</td>
<td>17.0</td>
<td>4.3</td>
</tr>
<tr>
<td>7. Snatch with squat</td>
<td>140.0</td>
<td>190.0</td>
<td>134.1</td>
<td>26.4</td>
<td>19.7</td>
<td>3.5</td>
<td></td>
</tr>
<tr>
<td>8. Chest lifting with squat</td>
<td>117.5</td>
<td>230.0</td>
<td>112.5</td>
<td>163.0</td>
<td>29.5</td>
<td>18.1</td>
<td>3.9</td>
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<tr>
<td>9. Squat with barbell</td>
<td>160.0</td>
<td>300.0</td>
<td>140.0</td>
<td>217.9</td>
<td>36.7</td>
<td>16.4</td>
<td>4.7</td>
</tr>
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</table>

### Table 2. Correlation matrix of analyzed data for men athletes

<table>
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<tr>
<th>Items</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Age</td>
<td>.00</td>
<td>.64</td>
<td>-.19</td>
<td>-.20</td>
<td>.08</td>
<td>.05</td>
<td>.05</td>
<td>.05</td>
<td>-.02</td>
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<tr>
<td>2. Years of training</td>
<td>.00</td>
<td>-.16</td>
<td>-.16</td>
<td>.40</td>
<td>.39</td>
<td>.41</td>
<td>.38</td>
<td>.34</td>
<td></td>
</tr>
<tr>
<td>3. Height</td>
<td>.00</td>
<td>.72</td>
<td>.52</td>
<td>.53</td>
<td>.46</td>
<td>.50</td>
<td>.46</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Body weight</td>
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<td>.73</td>
<td>.74</td>
<td>.71</td>
<td>.75</td>
<td>.74</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Snatch</td>
<td>.00</td>
<td>.97</td>
<td>.79</td>
<td>.97</td>
<td>.92</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Clean and Jerk</td>
<td>.00</td>
<td>.95</td>
<td>.96</td>
<td>.95</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Snatch with squat</td>
<td>.00</td>
<td>.98</td>
<td>.94</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Chest lifting with squat</td>
<td>.00</td>
<td>.95</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Squat with barbell</td>
<td>.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4.) \( Y = 8.025325 + 0.784989X_1 + 0.243486X_2 \); 0.958 explained dispersion; 
   \( Y = \text{clean and jerk}, X_1 = \text{lifting to chest with squat}, X_2 = \text{squat with barbell to chest} \)
5.) \( Y = 6.402635 + 0.921721X_1 + 0.249764X_2 - 0.16438X_3 \); 0.959 explained dispersion; 
   \( Y = \text{clean and jerk}, X_1 = \text{lifting to chest with squat}, X_2 = \text{squat with barbell to chest}, X_3 = \text{snatch with squat} \)
6.) \( Y = -3.27687 \pm 0.69099X_1 + 0.251211X_2 - 0.59308X_3 + 0.681162X_4 \); 0.984 explained dispersion; 
   \( Y = \text{clean and jerk}, X_1 = \text{lifting to chest with squat}, X_2 = \text{squat with barbell to chest}, X_3 = \text{snatch with squat} \)

**Curve regression – quadratic**

1.) \( Y = -30.29250 + 1.1357651X - 0.0008398X^2 \); 0.941 explained dispersion 
   \( Y = \text{snatch}, X = \text{clean and jerk} \)
2.) \( Y = 36.59392 + 0.8231342X + 0.0010726X^2 \); 0.940 explained dispersion 
   \( Y = \text{clean and jerk} \)
3.) \( Y = -35.07680 + 1.8239729X - 0.0029959X^2 \); 0.954 explained dispersion 
   \( Y = \text{clean and jerk}, X = \text{snatch} \)
4.) \( Y = 31.80088 + 0.3668383X + 0.0018783X^2 \); 0.950 explained dispersion 
   \( Y = \text{clean and jerk}, X = \text{snatch with squat} \)
5.) \( Y = 45.97291 + 1.5628345X - 0.0020143X^2 \); 0.942 explained dispersion 
   \( Y = \text{snatch}, X = \text{lifting to chest with squat} \)
6.) \( Y = 68.24038 + 0.1549756X + 0.0029215X^2 \); 0.944 explained dispersion 
   \( Y = \text{squat with barbell to chest}, X = \text{lifting to chest with squat} \)
7.) \( Y = 91.83450 + 1.5404399X - 0.0018523X^2 \); 0.863 explained dispersion 
   \( Y = \text{snatch}, X = \text{squat with barbell to chest} \)
8.) \( Y = 197.26199 - 1.0109263X + 0.0072375X^2 \); 0.879 explained dispersion 
   \( Y = \text{squat with barbell to chest}, X = \text{lifting to chest with squat} \)
9.) \( Y = 9.34450 + 1.5211005X - 0.0012975X^2 \); 0.907 explained dispersion 
   \( Y = \text{clean and jerk}, X = \text{snatch with squat} \)
10.) \( Y = 18.22648 + 0.4411257X + 0.0008823X^2 \); 0.908 explained dispersion 
   \( Y = \text{snatch with squat}, X = \text{clean and jerk} \)
11.) \( Y = -17.31961 + 1.466074X - 0.0012048X^2 \); 0.953 explained dispersion 
   \( Y = \text{clean and jerk}, X = \text{squat with barbell to chest} \)
12.) \( Y = 36.18611 + 0.4416834X + 0.001179X^2 \); 0.953 explained dispersion 
   \( Y = \text{squat with barbell to chest}, X = \text{squat with barbell to chest} \)
13.) \( Y = -98.55936 + 1.7672525X - 0.00200X^2 \); 0.916 explained dispersion 
   \( Y = \text{clean and jerk}, X = \text{squat with barbell to chest} \)
14.) \( Y = 143.07484 - 0.2871002X + 0.0035118X^2 \); 0.922 explained dispersion 
   \( Y = \text{squat with barbell to chest}, X = \text{clean and jerk} \)
15.) \( Y = -14.87480 + 0.9517041X - 0.0002269X^2 \); 0.961 explained dispersion 
   \( Y = \text{snatch with squat}, X = \text{lifting to chest with squat} \)
16.) \( Y = 22.01986 + 1.0055793X + 0.0003326X^2 \); 0.961 explained dispersion 
   \( Y = \text{lifting to chest with squat}, X = \text{snatch with squat} \)
17.) \( Y = -51.82730 + 1.0100274X - 0.0007017X^2 \); 0.880 explained dispersion 
   \( Y = \text{snatch with squat}, X = \text{squat with barbell to chest} \)
18.) \( Y = 133.95898 - 0.033117X - 0.0047378X^2 \); 0.884 explained dispersion 
   \( Y = \text{squat with barbell to chest}, X = \text{snatch with squat} \)
19.) \( Y = -50.92766 + 1.172776X - 0.0008533X^2 \); 0.907 explained dispersion 
   \( Y = \text{lifting to chest with squat}, X = \text{squat with barbell to chest} \)
20.) \( Y = 110.92154 + 0.1547454X + 0.0029798X^2 \); 0.911 explained dispersion 
   \( Y = \text{squat with barbell to chest}, X = \text{lifting to chest with squat} \)

The electronic models we have created with high reliability allow for punctual and express evaluation in men athletes.

To correctly compare the influence of preparatory exercises on competitive exercises we have followed identical methods in all analyzed age groups. The methods consisted of consistent increase of the medium values in the multiple regression models on the basis of the high functional relations in the analyzed groups as well as following the results and the effects of the preparatory exercise.

As in previous research with elite men athletes, women athletes and the present experimental research, we established that the competitive exercise clean and jerk is influenced mainly by the basic preparatory exercises clean and jerk with squat (R = 0.973) and lifting to chest with squat (R = 0.968) while these relations reach functional values. These functional relations presuppose the functional multiple regression – with 0.952 explained dispersion (Formula 3) between the discussed items.

For example, increasing the medium values of the preparatory exercises consistently with 5 (Formula 5) we can notice the following: increased value of 5% in the preparatory exercise clean and jerk with squat should increase the competitive exercise clean and jerk from 153.563 kg to 157.779 kg or with 4.249 kg, while the same proportional increase in the preparatory exercise lifting to chest with squat theoretically will calculate increase in the clean and jerk from 153.563 kg to 156.551 kg or with 2.988 kg.

These differences are even more pronounced in the analysis of the competitive exercise snatch and its relations with the preparatory exercises lifting to chest with squat (R = 0.995) and snatch with barbell to chest (R = 0.965). These functional relations create multiple regression – with 0.958 explained dispersion between the discussed values. On the basis of medium data (Formula 19), we found that in lifting to chest with squat – 163.036 kg and squatting with barbell 217.902 kg the equivalent achieve-
ment for the competitive exercise snatch is 189.063 kg. In these extremely high correlations it’s logical to think that the increase of the competitive exercise snatch will also lead to increase in the competitive exercise clean and jerk. At the same time, the higher correlation weight of the exercise lifting to chest with squat in comparison with the squat with barbell to chest should determine the strategy in the preparation of men athletes in clean and jerk. For example, if we increase with 5% the achievement in the lifting to chest from 217.902 to 228.797 kg with constant achievement of 163.036 kg in the lifting to chest with squat, the achievement in the snatch should increase from 189.063 to 191.716 kg or with 2.653 kg (1.403%). Meanwhile, the reciprocal increase of the mean achievement in lifting to chest with squat from 163.036 kg with constant achievement in squat with barbell to chest of 217.902 kg should theoretically lead to increase in the achievement in the clean and jerk from 189.063 kg to 195.462 kg or 6.339 kg (3.385%). An explanation of this phenomenon can be found in the old methods which do not allow balanced physical development of the different muscle groups.

CONCLUSION
- The existence of functional relations and equivalent variability between competitive and preparatory exercises give the opportunity for creating mathematical models for optimizing the training process of men power lifters.
- The regression equations make it possible to find the potential disproportions between the values of the competitive and basic preparatory exercises.
- Overcoming of the functional asymmetry while increasing the achievements will contribute to a more balanced physical and technical development of power lifters, as well as is a good prevention from injury.

REFERENCES
Боянов, Вл. (2010). Алгоритъм на глупостта – или как целио дневното гладуване води до затлъстяване. [Algorithm stupidity - or how fast all day leads to obesity. In Bulgarian.] Образование, 6(6), 105-110.

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