THE INFLUENCE OF SOME RELEVANT BIOMECHANICAL PARAMETERS ON THE RESULTS IN THE DISCIPLINE 100 METERS IN BUTTERFLY SWIMMING IN WOMEN’S SWIMMING EVENTS AT THE OLYMPIC GAMES IN ATLANTA – 1996

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Abstract
The investigation was conducted on a stratified sample of 16 woman swimmers, participants in the final competitions (A and B final), in discipline 100 meters in butterfly swimming of women's swimming at the Olympic games held in Atlanta 1996. Eight (8) biomechanical variables, relevant for specific events were analyzed. Regression analysis was applied and it was obtained a significant impact of the biomechanical (predictor) variables on the final result (FREZ). On the basis of the obtained result we conclude that all of the hypotheses were corroborated.

Key words: biomechanical variables, swimming, Olympic games, regression analysis

INTRODUCTION
There are few areas of human creativity and action in which the goal is so precisely determined as is the case in sports, and that's the sports results. In swimming, this goal is even more rigorously determined: in a particular discipline, and that of swimming to beat the shortest possible time.

At all important swimming competitions, especially the Olympics, as the world’s foremost sports event, which is held every four years, swimmers (and other athletes) perform with a single objective, and that is, to achieve their most valuable result, that will provide the best result, and crown their sports career.

Achieving top results in swimming, are conditional and depend on a number of factors such as: individual physical and functional abilities; optimal general conditions for preparation (modern facilities, props, accessories, opportunities for realization, year-round program); professional work at a high level; “sporting life style”; personal desire for progress and success etc.

One of the most important components in durability and painstaking process of preparation and swimmers competition, actually represents identification of these parameters that are an integral part of every practice and competition. Hence, the application of appropriate analyzes and change of specific exercises and methods during the training, can enhance and improve the most important biomechanical parameters of each race, but at the same time can eliminate eventually emerging vulnerabilities.

The corresponding analysis of biomechanical parameters of each race allows available and true information for the coach and swimmer for the required score in each segment of the race, along with the frequency and stroke amplitude.

This analysis helps in identification of the parameters that were optimally performed, and at the same time helps to identify those parameters that are necessary to be improved during the training and in future competitions.

RESEARCH SUBJECT
The research subject of this research is some relevant biomechanical parameters registered in the final participants at final competition (A and B finals) in the 100 meters butterfly discipline in women’s swimming at the Olympics in Atlanta in 1996.
RESEARCH GOAL AND TASK

The main objective of this research is the application of regression analysis in the 100m discipline female butterfly swimming in women’s swimming, suits to establish relations and partial impact of applied biomechanical parameters on FREZ. The subject and purpose of the research require the implementation of specific tasks:
- For each variable to determine the homogeneity of the results;
- To determine the degree of interconnectedness of the applied variables;
- To determine the impact of the applied system of predictor variables on Final Result;
- To determine the partial influence of the applied variables on FREZ.

HYPOTHESIS

Taking into account the research subject, research goal and tasks survey stratified sample, respondents as well as our experiences and knowledge, allows extraction of certain hypotheses, which are defined as expected:
- H1: There is a high degree of homogeneity of results in all studied parameters;
- H2: There is a high degree of interconnectivity of the analyzed variables;

METHOD

The sample of respondents is defined as stratified and it consists 16 participants in final competition (A and B) final, in discipline of butterfly 100 m woman in woman swimming in the Olympic Games, which was held in Atlanta in 1996, regardless of their age, which means that it is irrelevant.

The sample consists 8 biomechanical variables: The final result, seconds (FRES); Startup time , sec. and 15 m swimming sec. (STTSWIS); Clean swim speed, m/sec (PUSWM); Frequency, min. (FMIN); length of strokes, m (LESM); turning time, seconds and 15m swimming sec (TURT) ; turning Index (TURI); finish time, 7.5 m., Sec (FINT). In this study, the final result (FRES) is represented as criterion, and the others biomechanical parameters are represent as system of predictor variables.

RESULTS

The features of biomechanical variables of discipline 100 butterfly:
Table 1 presents descriptive statistics applied biomechanical variables in discipline 100 butterfly, based on the parameters of relative variability (CV%), a high degree of homogeneity of results can be determined, which is quite natural if we take into consideration the equal quality of the swimmers. In this discipline the slightest homogeneity of result is present in variable results FMIN and LESM.

Table 2 shows coefficients correlation between the applied variables and allows claims FRES variable statistically significantly and positively correlated with variables STTSWIS; PUSWIM and TURT which means that the final result is closely related to the time of the startup time, clean swim speed and the turning time.

In addition to the already mentioned correlation, variable STTSWIS is statistically significantly and positively related to variable TURT too.

Between variables STTSWIS and TURI there is a statistically significant correlation, but with a negative sign.

With careful analysis of Table 3, which presents the results of regression analysis criterion variable FRES 100 Butterfly, based on the multiple correlation coefficient (RO = 998), one can see that the applied system predictor variables has a statistically significant and positive impact on the result criterion variable, while based of coefficient determination (D = .996), it can be determined that the applied system predictor variables, participate in the explanation of the variance criterion variable with 99.6%.

Further analysis of this table, based on the level of significance of partial impacts predictor the outcome criterion variable Q (BETA), allows to determine the statistically significant and positive partial effects on the outcome criterion variable having variable STTSWIS; PUSWIM; TURT and FINT it is assumed that more successful in this discipline are swimmers who have faster startup, better time in clean swim and faster finish.

CONCLUSION

Based on a proper analysis of the results of the characteristics of the applied biomechanical variables in the 100m butterfly discipline, the following conclusions can be extracted in all applied biomechanical variables, based on the parameters of relative variability, a high degree of homogeneity of the results was found, which confirms the first set of hypothesis which is natural and expected,
Table 1 Basic statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>SD</th>
<th>CV%</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>FRES</td>
<td>60.54</td>
<td>.82</td>
<td>1.35</td>
<td>59.13</td>
<td>61.62</td>
</tr>
<tr>
<td>STTSWIS</td>
<td>7.09</td>
<td>.26</td>
<td>3.67</td>
<td>6.57</td>
<td>7.47</td>
</tr>
<tr>
<td>PUSWIM</td>
<td>39.33</td>
<td>.61</td>
<td>1.55</td>
<td>37.53</td>
<td>39.97</td>
</tr>
<tr>
<td>FMIN</td>
<td>55.40</td>
<td>4.64</td>
<td>8.05</td>
<td>43.30</td>
<td>63.70</td>
</tr>
<tr>
<td>LESM</td>
<td>1.69</td>
<td>.21</td>
<td>12.88</td>
<td>1.09</td>
<td>1.87</td>
</tr>
<tr>
<td>TURT</td>
<td>9.07</td>
<td>.26</td>
<td>2.86</td>
<td>8.67</td>
<td>9.53</td>
</tr>
<tr>
<td>TURU</td>
<td>.01</td>
<td>.03</td>
<td>.3</td>
<td>-.05</td>
<td>.07</td>
</tr>
<tr>
<td>FINT</td>
<td>5.07</td>
<td>.14</td>
<td>2.74</td>
<td>4.80</td>
<td>5.45</td>
</tr>
</tbody>
</table>

Table 2 correlation matrix

<table>
<thead>
<tr>
<th></th>
<th>FRES</th>
<th>STTSWIS</th>
<th>PUSWIM</th>
<th>FMIN</th>
<th>LESM</th>
<th>TURT</th>
<th>TURU</th>
<th>FINT</th>
</tr>
</thead>
<tbody>
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<td>FRES</td>
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<td>.63</td>
<td>.79</td>
<td>-.25</td>
<td>.63</td>
<td>-.12</td>
<td>.04</td>
<td></td>
</tr>
<tr>
<td>STTSWIS</td>
<td>.63</td>
<td>1.00</td>
<td>.14</td>
<td>.18</td>
<td>-.13</td>
<td>.83</td>
<td>-.49</td>
<td>-.31</td>
</tr>
<tr>
<td>PUSWIM</td>
<td>.79</td>
<td>.14</td>
<td>1.00</td>
<td>.11</td>
<td>-.28</td>
<td>.09</td>
<td>.41</td>
<td>-.07</td>
</tr>
<tr>
<td>FMIN</td>
<td>.12</td>
<td>.18</td>
<td>.11</td>
<td>1.00</td>
<td>.40</td>
<td>.10</td>
<td>-.09</td>
<td>-.29</td>
</tr>
<tr>
<td>LESM</td>
<td>-.25</td>
<td>-.13</td>
<td>-.28</td>
<td>.40</td>
<td>1.00</td>
<td>-.00</td>
<td>-.18</td>
<td>-.03</td>
</tr>
<tr>
<td>TURT</td>
<td>.63</td>
<td>.89</td>
<td>.09</td>
<td>.10</td>
<td>-.00</td>
<td>1.00</td>
<td>-.73</td>
<td>-.06</td>
</tr>
<tr>
<td>TURU</td>
<td>-.12</td>
<td>-.49</td>
<td>.41</td>
<td>-.09</td>
<td>-.18</td>
<td>-.73</td>
<td>1.00</td>
<td>-.23</td>
</tr>
<tr>
<td>FINT</td>
<td>.04</td>
<td>-.31</td>
<td>-.07</td>
<td>-.29</td>
<td>-.03</td>
<td>-.06</td>
<td>-.23</td>
<td>1.00</td>
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</table>

Table 3 regression analysis of variable FRES

<table>
<thead>
<tr>
<th>Variable</th>
<th>BETA of BETA</th>
<th>B</th>
<th>of B</th>
<th>t-test</th>
<th>Q (BETA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>STTSWIS</td>
<td>.401777</td>
<td>1.249705</td>
<td>.137176</td>
<td>9.11025</td>
<td>.000017</td>
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<td>PUSWIM</td>
<td>.792903</td>
<td>.972035</td>
<td>.044231</td>
<td>21.9761</td>
<td>.000000</td>
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<tr>
<td>FMIN</td>
<td>-.001307</td>
<td>-.000239</td>
<td>.004674</td>
<td>-.05117</td>
<td>.960442</td>
</tr>
<tr>
<td>LESM</td>
<td>.027633</td>
<td>.108497</td>
<td>.097701</td>
<td>1.11050</td>
<td>.299043</td>
</tr>
<tr>
<td>TURT</td>
<td>.259336</td>
<td>.812638</td>
<td>.194604</td>
<td>4.17585</td>
<td>.003097</td>
</tr>
<tr>
<td>TURU</td>
<td>.022642</td>
<td>.589565</td>
<td>1.369554</td>
<td>.43048</td>
<td>.678209</td>
</tr>
<tr>
<td>FINT</td>
<td>.237242</td>
<td>1.084591</td>
<td>.123180</td>
<td>8.80495</td>
<td>.00022</td>
</tr>
</tbody>
</table>

R = .998  R² = .996  SIGMA = .6  F = 357.38  Q(F) = .000

having in mind the pretty equal quality of swimmers.

Of applied biomechanical variables, slightest homogeneity is present in variable results FMIN (frequency or number of strokes in a minute) and LESM (length of stroke), which is due to differences in morphological characteristics of swimmers and application of different variants of technique.

Among the applied biomechanical variables, there is statistically significant and mostly positive connection FRES (final score) found with variable startup time, clean swim, turning time and finish time, which confirms the second set hypothesis.

Based on the multiple correlation coefficients in the analyzed discipline, it has been found statistically significant and positive impact of the applied system predictor variables on the final result, represented as a criterion variable, thus confirming the third hypothesis.
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ВЛИЈАНИЕТО НА НЕКОИ РЕЛЕВАНТНИ БИОМЕХАНИЧКИ ПАРАМЕТРИ ВРЗ РЕЗУЛТАТИТЕ ВО ДИСЦИПЛИНАТА 100 МЕТРИ ДЕЛФИН НА ЖЕНСКОТО ПЛИВАЊЕ НА ОЛИМПИЈСКИТЕ ИГРИ ВО АТЛАНТА 1996 ГОДИНА

УДК: 796.212.6-055.2:796.033.2(73)“1996”
(Оригинален научен труд)

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Апстракт
Изведено е истражување на примерок од 16 пливачи, учесници во финалните навигација на 100 метри делфин на женскиот пливање на Олимписките игри одржани во Атланта 1996 година, во кои се применил и анализирани 8 биомеханички варијабли, заеднички во секоја дисциплина. Со приложена регресиска анализа утврдено е парциалното влијание на навечените биомеханички варијабли, предвидени како предиктори за резултатот на критериумските варијабли, конечен резултат (КРЕЗ). Врз основа на добени резултати може да се утврдат дека се добени резултати како очекувани.

Ключни зборови: биомеханички варијабли, пливање, Олимписките игри, регресиска анализа

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