Correlative aspects regarding the resistance to mental fatigue and the junior gymnasts’ performance

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Abstract

The purpose of this study consists of analyzing the existing correlations between the resistance to mental fatigue and the performance obtained by gymnasts in a competition. The computerized test RNE (Resistance to Mental Fatigue RNE Test), within PSISELTEVA tests, elaborated by RQ Plus, has been conceived in order to evaluate the resistance to mental fatigue. The subjects who took part in this study are 8 junior gymnasts, from C.S.S. 7 Dinamo Bucharest. Using the Spearman correlation there have been important relations highlighted between the performance coefficient (appreciated through the rapport between the vigilance and the simple reaction time) and the mark obtained in the competition for the following apparatus: rings, parallel bars and horizontal bar.

1. Introduction

Men’s artistic gymnastics, as an all-round competition with six trials, re-unites a variety of elements and technical procedures of great difficulty, being seen as a higher form of manifestation of the athlete’s psychomotor capacity. The technical content specific to each apparatus is based on physical, functional and psychological requests, which may vary according to a number of factors. Of these, the individual particularities, the preparation degree, the motivation and aspiration level oblige the athletes to entirely mobilize their resources and to display a very good behavioral balance that might assure the stability of skills.

The space, temporal and energy characteristics of movement included in each type of exercise demand the athletes’ special cognitive processes, such as memory, thinking and imagination, but especially attention, with certain characteristics of duration, stability, concentration, volume and distribution, which differs from one

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apparatus to another. It is well known that attention supports and directs motor skills which need coordinative capacities and permanent motor control [Epuran, Holdevici, & Toni, 2001]. This fact is reflected in the gymnast’s psychological preparation. The major goals are the development of resistance to mental fatigue and forming of necessary skills to build a strong psyche, through which the athlete must avoid entering a “state of panic” in extreme situations.

In gymnastics, Grigore [2001] makes reference to the interactions between the cognitive processes, stating that motor achievements depend on the concentration capacity which is limited by the fatigue that appears faster when training a young athlete. Studies show that long periods of cognitive activity are responsible for inducing a mental fatigue state, a state subjectively felt by the athlete [Boksem, & Tops, 2008] and manifested through errors in executions. The literature on mental fatigue in elite sport performance discuss about different dimensions such as self-belief, desire/motivation, dealing with pressure and anxiety, focus (performance-related), focus (lifestyle-related), and pain/hardship factors, those being specific to the mental toughness concept [Jones, 2002]. Nevertheless, specialized literature does not provide a great amount of information regarding the influence of mental fatigue on technical skills execution and on the obtained performance [Marcora, Staiano, & Manning, 2009].

2. Organization of the research

2.1. The purpose of the research

This study wants to identify the existing correlations between the resistance to mental fatigue and sports performance, in the field of junior men’s artistic gymnastics.

2.2. Subjects

The sample included 8 gymnasts, aged between 13 and 15 years, from C.S.S. 7 Dinamo Bucharest. The athletes have 7 to 10 years experience in their performance field, including several national champions. 5 of the members were part of the Junior Team III, level 3, and the other 3 were in the Junior Team II, level 2, during the Team Men’s Artistic Gymnastics National Championship, between 14-16 June 2012, in Bistrița.
2.3. Methods

To solve the research issues, we used: observation, conversation, test – Resistance to Mental Fatigue RNE Test, within PSISELTEVA tests, elaborated by RQ Plus, statistical processing methods – SPSS and data interpreting.

2.3.1. Description and development

The computerized RNE test evaluates the resistance to mental fatigue, behavioral stability in stand-by and disruptive conditions. On the screen of the monitor one can see two signs “Danger” (red circles with the exclamation mark sign) placed on the left/right, a rectangle with three colored circles (green on the left, red in the centre and yellow on the right) and a window with error alert. At random periods of time the red color disappears – a phenomenon that represents the appearance of a signal-stimulus. Likewise, at random periods of time and with a random location on the right/left the sign “Danger” appears – a phenomenon that represents the appearance of a signal-stimulus. A lever and two pedals were available for the participant and the task requested was to give answers by pushing the left button of the lever when the red light signal disappeared and by pushing the left/right pedal when the sign “Danger” appeared on the right/left side. The gymnasts were tested during the competition training period, within an assessing lesson, one week before the National Championship.

2.3.2. Results of the test

- The mean of the reaction time for the red color signal-stimulus;
- Vigilance coefficient (corrects at the light/ total light stimuli number);
- Performance coefficient (qualitative measurement statistically calculated by reporting the vigilance coefficient to the mean of the reaction time).

The results obtained by the gymnasts at the RNE test have been correlated to the scores offered by the referees, for each apparatus execution (floor, pommel horse, rings, vault, parallel bars and horizontal bar), during the Junior Team National Championships.

3. Results

Preliminary data analysis (box-plot chart) has emphasized that in the case of the performance coefficient and in the case of the scores given by the referees, there were no excessive values – marginal or extreme (for the execution on each apparatus – floor, pommel horse, rings, vault, parallel bars and horizontal bar). We present, for example, the box-plot for the scores obtained at rings and floor.

![Box-plot chart](image)

Fig.1. Extreme values – (a) rings; (b) floor
Using the Spearman correlation, we have verified if there were any relations between the resistance to mental fatigue (the performance coefficient of the RNE computerized sample) and the sports performance – the scores given by the referees, for the execution of the gymnasts on each apparatus.

The following conditions for the application of the Spearman correlation are fulfilled:
- Both variables are ordinal or one of them is quantitative and the other ordinal;
- The sample has a reduced volume (8 subjects);
- The scores of a variable are monotonously related to the scores of the other variable, meaning that, once the values of a variable register growth, the values of the other variable will also grow (decrease) – but not necessarily in a linear manner.

Table 1. Results for the performance coefficient and for the scores obtained by the gymnasts at floor, pommel horse, rings, vault, parallel bars and horizontal bar

| Variables          | N | m     | s   | performance | RNE coefficient | Spearman’s rho  
<table>
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<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Correlation Coefficient</td>
</tr>
<tr>
<td>performance</td>
<td>8</td>
<td>3.61</td>
<td>0.15</td>
<td></td>
<td>1.000</td>
<td></td>
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<tr>
<td>RNE coefficient</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>floor</td>
<td>8</td>
<td>13.32</td>
<td>0.87</td>
<td></td>
<td>-0.036</td>
<td></td>
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<tr>
<td>pommel horse</td>
<td>8</td>
<td>11.88</td>
<td>1.84</td>
<td></td>
<td>0.096</td>
<td></td>
</tr>
<tr>
<td>rings</td>
<td>8</td>
<td>13.26</td>
<td>0.54</td>
<td></td>
<td>0.842**</td>
<td></td>
</tr>
<tr>
<td>vault</td>
<td>8</td>
<td>12.78</td>
<td>0.57</td>
<td></td>
<td>0.222</td>
<td></td>
</tr>
<tr>
<td>parallel bars</td>
<td>8</td>
<td>12.06</td>
<td>1.79</td>
<td></td>
<td>0.721*</td>
<td></td>
</tr>
<tr>
<td>horizontal bar</td>
<td>8</td>
<td>12.86</td>
<td>1.33</td>
<td></td>
<td>0.783*</td>
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</tr>
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**. Correlation is significant at the .01 level (2-tailed).
*. Correlation is significant at the .05 level (2-tailed).

The analysis of the results indicated in table number 1 emphasizes:
- There is no correlation between the resistance to mental fatigue (the performance coefficient) and the scores obtained for the gymnasts’ routines at floor (p > 0.05);
- There is no correlation between the resistance to mental fatigue (the performance coefficient) and the scores obtained for the gymnasts’ routines at pommel horse (p > 0.05);
- There is a positively significant correlation (0.842) between the resistance to mental fatigue (the performance coefficient) and the scores obtained for the gymnasts’ routines at rings (p < 0.05);
- There is no correlation between the resistance to mental fatigue (the performance coefficient) and the scores obtained for the gymnasts’ routines at vault (p > 0.05);
- There is a positively significant correlation (0.721) between the resistance to mental fatigue (the performance coefficient) and the scores obtained for the gymnasts’ routines at parallel bars (p < 0.05);
The determination coefficient ($r^2$) has a 0.52 value, meaning that the relation between the resistance to mental fatigue and the performance of gymnast on the parallel bars apparatus is very powerful.

There is a positively significant correlation (0.783) between the resistance to mental fatigue (the performance coefficient) and the scores obtained for the gymnasts’ routines at horizontal bar ($p < 0.05$);

With respect to the effect size index ($r^2 = 0.61$) it is noticeable that the relation between the resistance to mental fatigue and the performance of the gymnasts on the horizontal bar apparatus is very powerful.

4. Conclusions

This study demonstrates the existence of several significant statistic correlations between the resistance to mental fatigue and the athletes’ performance for three of the six apparatus specific to men’s artistic gymnastics. Due to the fact that technical elements have a different difficulty degree and because the mental fatigue disturb the motor executions, we can assert that the resistance to mental fatigue modifies the accuracy of the routines. The performance coefficient (RNE) registered different values depending on the psycho-motor strain specific to each apparatus and demonstrated a strong relation with the contest results for rings, parallel bars and horizontal bar. This can be explained through the particular biomechanics of certain technical elements which require separation from the apparatus, changes of the space and time coordinates aspects that give the execution a greater risk degree. In such conditions, the mental-physical solicitation is stronger. The gymnast has to concentrate his attention on the correct position of the body and of the limbs, on the trajectory of the motor actions, on reaching the apparatus again and on making a relationship with the following elements. All these aspects have to be solved at the same time, in order to assure the accuracy of the movement and a lower risk of injuries. When talking about the following apparatus: floor, pommel horse and vault, it was discovered that the resistance to mental fatigue, appreciated through the value of the performance coefficient (RNE test), does not have any significant statistical relation to the score obtained in the competition. We can explain this aspect through the conditions in which the routines take place, the contact with the support surface offering a higher degree of safety to the gymnast. Regarding the floor and vault apparatus the standing position prevails, when it comes to the pommel horse apparatus the gymnast relies on support, while for rings, parallel bars and horizontal bar, the positions alternate between hanging and supporting. Our research has been limited by the physical and mental state of the subject during testing (fatigue, affective-motivational factors) which may cause variations in motor responses. Observation and conversation as research methods support the value of our research, which is based on the study of resistance to mental fatigue. Another limitation is represented by the sample of athletes. The situation could be different if the sample would be constituted, for example, only from female athletes or if we would have investigated more than 8 participants. Given the fact that the specific domain references analyze in a poor manner the aspects that we were interested in, this paper can be considered a starting point for further deeper researches and a reflective subject for the specialists. The results of this study offer important information to the specialists both with respect to elaborate the training methodology and to establish the tactics for the competition. The RNE test, part of the PSISELTEVA series, may be used as a complementary means of psychological preparation, may offer data with respect to the resistance to mental fatigue, which may become objective points in specific training, and may also represent an element of selection of the gymnasts for the representative team.

References