Comparative Analysis of Psychophysiological Indicators for Athletes in Game Sports during Performance of Tactical and Technical Actions in Competitive Conditions

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Abstract: The purpose of this article is to establish differentiated influence of psychophysiological state (PPS) indicators for game sports athletes on efficiency of their competitive activity. The possibilities of vibraimage technology in realization of prompt diagnostics task of athletes were investigated. Comparative analysis of individual parameters of athletes PPS ensuring to a large extent efficiency of their competitive activity was carried out. It is determined that mutual balance of three most significant parameters, in particular: aggression, energy and self-regulation, provides demonstration of stable results in qualified athletes of game sports.

Keywords: Psychophysiological state, vibraimage technology, efficiency of competitive activity, qualified athletes of game sports, aggressiveness, aggression, energy, self-regulation.

The modern system of training high-class athletes is inconceivable without a reliable apparatus of instrumental techniques aimed at diagnosing their psychophysiological state (PPS), the main goal of which is to optimize the management process for achieving the maximum possible result. PPS parameters of athletes largely determines the success of the performance of tactical and technical actions, ensuring the achievement of the corresponding result. The use of new methods in obtaining urgent information about the state of the players before the competition, during the competition or directly in the match can significantly increase their potential due to the adoption of timely management decisions.

Methods of on-line contactless psychophysiological diagnostics, among which the most promising is vibraimage technology, allow quickly receive information of PPS parameters and quickly interpret it. Monitoring the players’ PPS during the period of important competitions is the key to achieving the planned goal. However, in order to determine the readiness of athletes for important matches, it is necessary to determine and study the influence of individual parameters of their PPS on the efficiency of performance of tactical and technical actions.

Previous studies have identified the 10 most promising parameters (indicators) from our point of view: stress, anxiety (tension), suspect, balance, energy, self-regulation, inhibition, aggression (aggressiveness), neuroticism, charm (Lutkova, 2019). This choice is because each of the indicators reflects both the psychophysiological and behavioral characteristics of athletes.

In this regard, the purpose of this study is to establish the differentiated influence of the PPS indicators of game sportsmen on the effectiveness of their competitive activity. The study assumed that the influence of individual parameters of players' PPS on the effectiveness of their performance of tactical and technical actions would reveal the most significant parameters for stable results.

Methods and Results

The object of the study were qualified rugby athletes in the amount of 16 people, among whom 10 people have the title of Master of Sports (MS) and 6 are candidates for Master of Sports (sub-master, SM), 4 athletes are from national Russian team.

Vibraimage technology (Minkin, 2007; 2020) with VibraMed10 program (VibraMed10, 2020) used as the main research method for PPS parameters measurement. At the first stage, the psychophysiological state of the participants of study at rest was determined. At the second stage, along with PPS diagnostics, in the course of playing activity, the effectiveness of performing tactical
and technical actions (TTA) of rugby players was recorded. TTA effectiveness of rugby players was assessed by positive and negative actions: won bouts, corridors, crabs, mauls, territories.

This approach is based on the principle of the ball possession and its use by the attacking team, where TTA is conventionally divided into four groups: First group – standard positions: kick-off, 22-meter kick, scrum assigned and lineout. The second group – semi-standard positions: crab, maul. The third group – playing with hands: attacks of defenders, attacks of forwards, attacks of defenders with connecting forwards, playing on the “back line” (analysis of all attacks based on the concept of a channel system in the organization of the game). The fourth group – leg play: tactical strikes, attacking; short and high blows with a candle, shots on goal, shot-goals and kicks on the back line (Ivanov, 2006). After that, the comparative analysis of the game performance and PPS parameters was done.

**Results and Discussion**

In solving this problem, the key issue, on the one hand, is the question of changing the selected parameters of the PPS of athletes under the influence of high psycho-emotional tension under the influence of intense competitive loads. On the other hand, how and to what extent they affect the effectiveness of TTA performance. TTA performance indicators will make it possible more accurately determining the significance of each individual parameter of PPS in the overall sports result.

To solve the problem of the first stage, the current PPS of the players were tested. The results are presented in table 1.

**Table 1**
The results of psychophysiological parameters testing of qualified game sportsmen at rest (n = 16)

<table>
<thead>
<tr>
<th>Parameters</th>
<th>M±S</th>
<th>Vi (S/M)</th>
<th>bMin</th>
<th>bMax</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggression</td>
<td>43,70±6,96</td>
<td>15,98</td>
<td>20,00</td>
<td>50,00</td>
</tr>
<tr>
<td>Stress</td>
<td>27,50±3,21</td>
<td>11,90</td>
<td>20,00</td>
<td>40,00</td>
</tr>
<tr>
<td>Tension</td>
<td>28,92±8,95</td>
<td>33,67</td>
<td>15,00</td>
<td>40,00</td>
</tr>
<tr>
<td>Suspect</td>
<td>33,36±4,03</td>
<td>12,26</td>
<td>20,00</td>
<td>50,00</td>
</tr>
<tr>
<td>Balance</td>
<td>63,59±6,95</td>
<td>11,60</td>
<td>50,00</td>
<td>100,00</td>
</tr>
<tr>
<td>Charm</td>
<td>76,41±4,12</td>
<td>5,50</td>
<td>40,00</td>
<td>100,00</td>
</tr>
<tr>
<td>Energy</td>
<td>24,03±3,89</td>
<td>16,54</td>
<td>10,00</td>
<td>50,00</td>
</tr>
<tr>
<td>Self-Regulation</td>
<td>69,75±4,57</td>
<td>6,65</td>
<td>50,00</td>
<td>100,00</td>
</tr>
<tr>
<td>Inhibition</td>
<td>17,96±3,42</td>
<td>18,62</td>
<td>10,00</td>
<td>25,00</td>
</tr>
<tr>
<td>Neuroticism</td>
<td>34,16±12,23</td>
<td>35,98</td>
<td>10,00</td>
<td>50,00</td>
</tr>
</tbody>
</table>

Designation: M – average value of a parameter for a given period; S is the standard deviation of measured parameter; Vi – variability of measured parameter; indicators bMin and bMax – minimum and maximum value of measured parameter.

The initial data obtained indicate that no significant deviations were found in the participants testing at rest. Almost all of them are in the normal distribution range. At the second stage, the players’ PPS testing took place before the competition, during which tactical and technical actions were recorded, the percentage of positively performed techniques was determined. The results of the revealed ratio are presented in table 2.

**Table 2**
The effectiveness of competitive activity of game sportsmen, depending on their psychophysiological state parameters (%)

<table>
<thead>
<tr>
<th>Parameters</th>
<th>20-40% (n=4)</th>
<th>40-60% (n=4)</th>
<th>60-80% (n=5)</th>
<th>Unstable efficiency (n=3)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M±S</td>
<td>M±S</td>
<td>M±S</td>
<td>M±S</td>
</tr>
<tr>
<td>Aggression</td>
<td>35,55±6,24</td>
<td>41,63±6,46</td>
<td>46,24±7,05</td>
<td>53,09±8,45</td>
</tr>
</tbody>
</table>
Obtained data indicate that there are significant differences in the ability of athletes to successfully perform tactical and technical actions depending on their general psychophysiological state, which, due to tough opposition from the opponent's side, can change as quickly as it happens with the playing situation on the field.

Hence, the transient change in the PPS of rugby players is a short response of the body to the fleetingly changing playing situation. In such a rapidly changing environment, even qualified athletes show themselves from different angles. So, out of 16 people who took part in the study, only five showed the effectiveness of TTA within 60-80%, which is a sign of high skill. The other four rugby players showed the performance of TTA in the region of 40-60% and may well be attributed to the group of middle peasants.

The performance of the TTA of four more players varies in percentage from 20 to 40%, which cannot be considered satisfactory. Another category of athletes has been defined, the performance of TTA by which remains beyond the predictability. There were three people in this category, and they were assigned to the group of rugby players with unstable efficiency.

According to the results of the registration of the TTA, all rugby players were divided into four groups: with a high playing efficiency from 60 to 80%, with an average from 40 to 60%, with a low one from 20 to 40% and a group with unstable efficiency.

In connection with the differentiation of rugby players according to the effectiveness of playing activity, it became possible to conduct a comparative analysis of individual parameters of the athletes' PPS, which largely ensure the success of their TTA. Based on the data in table 2, there is an obvious tendency for the dominance of some “special” parameters, which have a significant impact on the result of TTA. Among those: aggression, charm, energy and self-regulation. The general picture of the discrepancies shown on figure 1 indicates the dynamics of these parameters in relation to the effectiveness of the players' actions.

Let's analyze the movement of these parameters using the example of visual perception. Figure 1 shows a diagram of the average value of these parameters and the efficiency of TTA for the entire sample of subjects. The range of registered minimum and maximum performance indicators for TTA is in the range from 20 to 80%. In general, the dynamics shown in figure 1 does not give a complete picture of the impact of each of these parameters on the effectiveness of actions.

This is primarily because the average statistical values for the entire sample of subjects cannot be informative and reliable in relation to a particular athlete. Therefore, it is necessary to study the dynamics of PPS parameters in groups of players with similar results in terms of TTA.
Rugby players, demonstrating the effectiveness of TTA from 20 to 40%, are distinguished by high charm and self-regulation with a clear lack of aggression and especially energy. Athletes in the group with a performance of 40-60% TTA demonstrate a higher level of aggression and energy with stable values of charisma and self-regulation. When performing TTA in competition conditions, players with a TTA performance of 60-80% show a unidirectional movement to increase aggression, self-regulation and energy. This movement is balanced. In a group of players with unstable efficiency, the reasons for the instability of the result lie in the plane of the still unformed mechanism for controlling their psychophysiological state and, as a result, the lack of reliability in the performance of TTA. In this category of athletes, playing techniques can be performed against the background of increased aggression, but the energy resource is insufficient for its success, or aggression and energy in magnitude can be extreme, but not controllable due to the inability to self-regulate this state.

The revealed dynamics of the difference between the PPS parameters of the players characterizes the greatest significance of some of them. Thus, the balance and mutual conditioning of aggression, self-regulation and energy allows us to judge the stability of the general PPS of athletes in a competitive environment. In addition, the psychophysiological stability of the acquired state ensures the stability of TTA in a constantly changing environment.

The facts noted in the course of the analysis indicate that the statement about the exclusive influence of a separate PPS parameter on the efficiency of the players' TTA is not correct. As shown in the study, the analysis of the current PPS of athletes must be approached from the position of complex assessment, in particular, taking into account at least three of the most essential indicators from 10 PPS parameters: aggression, energy and self-regulation.

Conclusion

The study of sportsmen's PPS in conditions of extreme competitive loads confirmed the assumption about the “law of rationality”, when among the numerous psychophysiological personality traits that ensure high performance of actions, the most significant were three indicators: aggression, energy and self-regulation.

It has been established that one individual indicator of total PPS of players does not guarantee the success of tactical and technical actions. Only a balance of several indicators (in this case, aggression, energy, self-regulation) demonstrates stable TTA results.

References: