The technique of control and analysis of changes of heart rate of wrestlers under the influence of exercise stresses with use of the computer application

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Purpose: to develop the software application for mobile computing devices, allowing increasing the quality of registration and the analysis of changes of HR in single combats.

Material & Methods: theoretical analysis and generalization of scientific and methodical literature, method of computer programming.

Results: the computer software application is developed, allowing carrying out registration and the subsequent analysis of HR during trainings or separate training loads of various orientation. Results, which allowed optimizing the procedure of the analysis of training loads in single combats, were received during the approbation of this application.

Conclusions: the analysis of dynamics of change of HR and perception of loading by the sportsman is the objective corrective action of load of the sportsman’s organism. The algorithm of the procedure of definition of HR after loading is developed and the contents of the analysis of the obtained data in the software application are selected. The software application for registration and the analysis of training load in single combats with use of mobile computing devices is developed and approved.

Keywords: heart rate, intensity zones, software computer application, mobile application, metabolic costs, single combats.

Introduction

The important part of the analysis of training loads of sportsmen is the accounting of their intensity. Today one of the available methods of assessment of reaction of organism to intensity of load is heart rate (HR) [3; 7; 13].

Now the continuous registration of HR is used by means of monitors of warm rhythm for control of functional condition of the sportsman [4; 5; 6]. The large number of computer programs, which allow carrying out the analysis of the values of HR rather informatively, which are received by means of such devices, is developed. Such approach has many advantages and proved the efficiency in many sports. Unfortunately, it cannot be used in full in single combats, in type of specifics of training and competitive activity, which are in direct and rigid contact with the rival that can damage expensive measuring equipment, and use of sensors of control of HR during rest between loads cannot always be quick [2; 9; 11]. All this confirms the relevance of search simple and enough reliable innovative methods and control devices of change of HR in single combats.

The purpose of the research:

to develop the software computer application for mobile devices allowing increasing quality of registration and the analysis of changes of HR in single combats.

Research problems:

1. To analyze data of special methodical literature concerning the technique of control and the analysis of changes of HR in single combats.

2. To develop algorithm of definition of HR after load and to select contents of the analysis of the obtained data in software application.

3. To develop and approve computer software application which can be used in single combats.

Material and Methods of the research

The following methods are used for the solution of purposes: theoretical analysis and generalization of scientific and methodical literature, method of computer programming.

Results of the research and their discussion

On the basis of studying of special literature, it is established that five zones of intensity of indicators of HR, which are peculiar both for amateur sportsmen, and for the qualified sportsmen, are allocated in modern classification of training and competitive loads [11; 12]. These physiological borders and pedagogical criteria are widely widespread in the training practice (tab. 1, 2).

The optimum range of motor activity for amateur sportsmen generally is determined by the method Karvonen. Borders of this range are approximately between value of pulse in quiet state and MHR (maximum heart rate) is able. The aimed zone of pulse is ranging from 50% to 80% of MHR and is chosen
The special formula appeared: 220 – age in 1970 thanks to William Haskell and Samuil Fox for the situation «here and now».

The scientific article in the Journal of the American College of Cardiology magazine on the subject: Age-predicted maximal heart rate revisited, in which it is offered to use for indirect determination of maximum permissible size of pulse formula: \( HR_{max} = 208 - (0.7 \times \text{age, in years}) \) is published in 2001 by the scientific Hirofumi Tanaka, PHD, Kevin D. Monahan, MS, Douglas R. Seals, PHD. It was developed on the basis of the researches, which were conducted with the participation of several thousand people, and at the moment this formula is standard by sports physiologists.

The algorithm of registration and the analysis of HR in single combats (pic. 1) are developed by results of the theoretical analysis and practical coach’s experience in single combats.

This algorithm became the basis for development of the computer application for mobile devices which allows to register HR and to carry out the preliminary analysis of the received data of HR is made by the program “Any mode of measurement of HR”, gives opportunity to evident demonstration of volume and dynamics of load with use of schedules and charts.

Results of researches in this mobile application can be kept in the database, are exported directly from the application to any text editor, to social networks “Facebook” or “Twitter”.

The analysis of the received data of HR is made by the program in warm-up, when performing of the offered load, at restoration after load and assumes demonstration of percentage ratio of stay of the sportsman in each zone of intensity of load, average, maximum and minimum value of pulse. Also the application gives opportunity to evident demonstration of volume and dynamics of load with use of schedules and charts.

The rather widespread technique among computer applications which use the touch screen “Touch Screen” is used for measurement of HR. The expert fixes the sportsman’s HR (palpation on radial or carotid arteries) and reproduces pulse rate, concerning the device screen. The program defines time intervals (demonstration of result requires not less than 7 contacts) and counts arithmetic average, the greatest and smallest interval are not considered.

The analysis of the obtained values is carried out tasks [2; 10].

At the beginning of work of mobile application it is necessary to choose sports qualification, in the tab “Introduction information” – surname, name of the sportsman, age, sex, body weight, and also orientation of training load.

It is also necessary to choose the mode of measurement of HR. The mobile application offers two options of measurement of HR:

1. “The fixed mode of measurement of HR”, assumes the choice of the fixed time interval of measurement of HR from 1 min. to 10 min., depending on duration of training load and its orientation;

2. “Any mode of measurement of HR”, gives opportunity to measure HR right after performance of training load.

It will be offered to enter reference value of HR (if the pulsator is used and the training load does not assume contact with the rival) or to measure reference value of HR after entrance to the necessary mode of measurement of HR.

The results, which are presented in this mobile application, will allow the coach to estimate more objectively reaction of organism of the sportsman to the executed training load and to quickly correct training process.

This software application is developed for use in mobile devices, under control of iOS (iPhone, iPad) and calculated first of all for coaches, sportsmen, students and teachers of specialized higher education institutions in their professional and scientific activity.

Conclusions

1. The analysis of dynamics of change of HR and perception of load by the sportsman is objective corrective action of load of the sportsman’s organism.

2. The algorithm of the procedure of definition of HR after load is developed and the contents of the analysis of the obtained values is carried out tasks [2; 10].

Table 1

<table>
<thead>
<tr>
<th>Intensity zones</th>
<th>% from max. HR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone of easy activity</td>
<td>50–60%</td>
</tr>
<tr>
<td>Aerobic zone</td>
<td>60–70%</td>
</tr>
<tr>
<td>Aerobic and anaerobic zone</td>
<td>70–80%</td>
</tr>
<tr>
<td>Anaerobic zone</td>
<td>80–90%</td>
</tr>
<tr>
<td>Maximum load</td>
<td>90–100%</td>
</tr>
</tbody>
</table>

Table 2

<table>
<thead>
<tr>
<th>№</th>
<th>Intensity zones</th>
<th>HR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Aerobic recovery zone</td>
<td>till 145 bpm⁻¹</td>
</tr>
<tr>
<td>2</td>
<td>Aerobic developing zone</td>
<td>till 175 bpm⁻¹</td>
</tr>
<tr>
<td>3</td>
<td>Aerobic and anaerobic zone</td>
<td>till 185 bpm⁻¹</td>
</tr>
<tr>
<td>4</td>
<td>Anaerobic and glycolytic zone</td>
<td>more than 185 bpm⁻¹</td>
</tr>
<tr>
<td>5</td>
<td>Anaerobic-alactate zone</td>
<td>work of the maximum power to 20 s</td>
</tr>
</tbody>
</table>
Choice of skill level of the sportsman:
1. The sportsman amateur.
2. The qualified sportsman

Viewing of the database

Information on the athlete and orientation of training load

The mode of the fixed interval of measurement of HR

The mode of any interval of measurement of HR

Input of HR value through certain interval of time (use of pulsator)

Measurement and input of HR value through certain interval of time (use of pulsator)

Fixing of HR value in warm-up, when performing of the set load, at restoration after load

Analysis of HR, creation of schedules, charts

Preservation of results in the database, with possibility of their demonstration

**Pic. 1. Algorithm of work of mobile application**

**Pic. 2. Mode of input of values of HR**
data in software application are selected. 

3. The software application for registration and the analysis of training load in single combats with use of mobile devices is developed and approved.

Prospects of further researches. Further researches are connected with possibility of more detailed analysis of reaction of organism of the sportsman to training loads with use of modern computer technologies.

Conflict of interests. The authors declare that there is no conflict of interests.

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References

1. Abzalov, R. A. & Sitdikov, F. G. (1998), Razvitvayushcheesaya sertse i dvigateelnyy rezhim [Developing heart and motor mode], Kazan, 95 p. (in Russ.)
3. Belotserkovskiy, Z. B. (2005), Ergometricheskie i kardiologicheskie kriterii fizicheskoy rabotosposobnosti u sportsmenov [Ergometric and cardiac criteria for physical performance in athletes], Sovetskiy sport, Moscow, 312 p. (in Russ.)
4. Voropay, S. N. & Guchenko, V. I. (2011), “Using a heart rate monitor «Sigma Sport 1300” in the operational control of special endurance cyclists higher categories (for example, cross-country)”, Pedagogika, psikhologiya i mediko-biologicheskie problemy fizicheskogo vospitanija i sporta, No 11, pp. 25–28. (in Russ.)
5. Kozina, Zh. L. (2007), “Methods of application of modern information technology to enhance the perception of figurative elements dealing with technology and tactics in sports games”, Pedagogika, psikhologiya i mediko-biologicheskie problemy fizicheskogo vospitanija i sporta, No 1, pp. 58–69. (in Russ.)
9. Rovnyy, A. S., Romanenko, V. V. & Pashkov, I. N. (2013), Ergometricheskie i kardiologicheskie kriterii fizicheskoy rabotosposobnosti u sportsmenov [Ergometric and cardiac criteria for physical performance in athletes], Sovetskiy sport, Moscow, 312 p. (in Russ.)

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