SLOBOZHANSKYI HERALD OF SCIENCE AND SPORT

UDK 796.8:796.015/303.42

ISSN (English ed. Online) 2311-6374
2016, № 6(56), c. 77-80

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

Table 1
Size of HR according to intensity zones for amateur sportsmen

Intensity zones	% from max. HR
Zone of easy activity	50–60%
Aerobic zone	60–70%
Aerobic and anaerobic zone	70–80%
Anaerobic zone	80–90%
Maximum load	90–100%

Table 2
Size of HR according to intensity zones for qualified sportsmen

№	Intensity zones	HR
1	Aerobic recovery zone	till 145 bpm^{-1}
2	Aerobic developing zone	till 175 bpm^{-1}
3	Aerobic and anaerobic zone	till 185 bpm^{-1}
4	Anaerobic and glycolytic zone	more than 185 bpm^{-1}
5	Anaerobic-alactate zone	work of the maximum power to 20 s

depending on individual distinctions in physical condition of the person [1; 8].

Indicators of the maximum heart rate (MHR) at sportsmen absolutely different also are depending on sex, age, degree of fitness and many other factors. It is possible to define individual value of the maximum heart rate only after passing of special tests on the corresponding equipment and under the leadership of skilled experts [14, 15].

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 x 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 values.

Appeal of mobile devices (tablets, smartphones) consists first of all in their portability, in good technical characteristics and simplicity of communication with the user. Use of the special software on these devices increases quality and speed of the 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 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 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.

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".

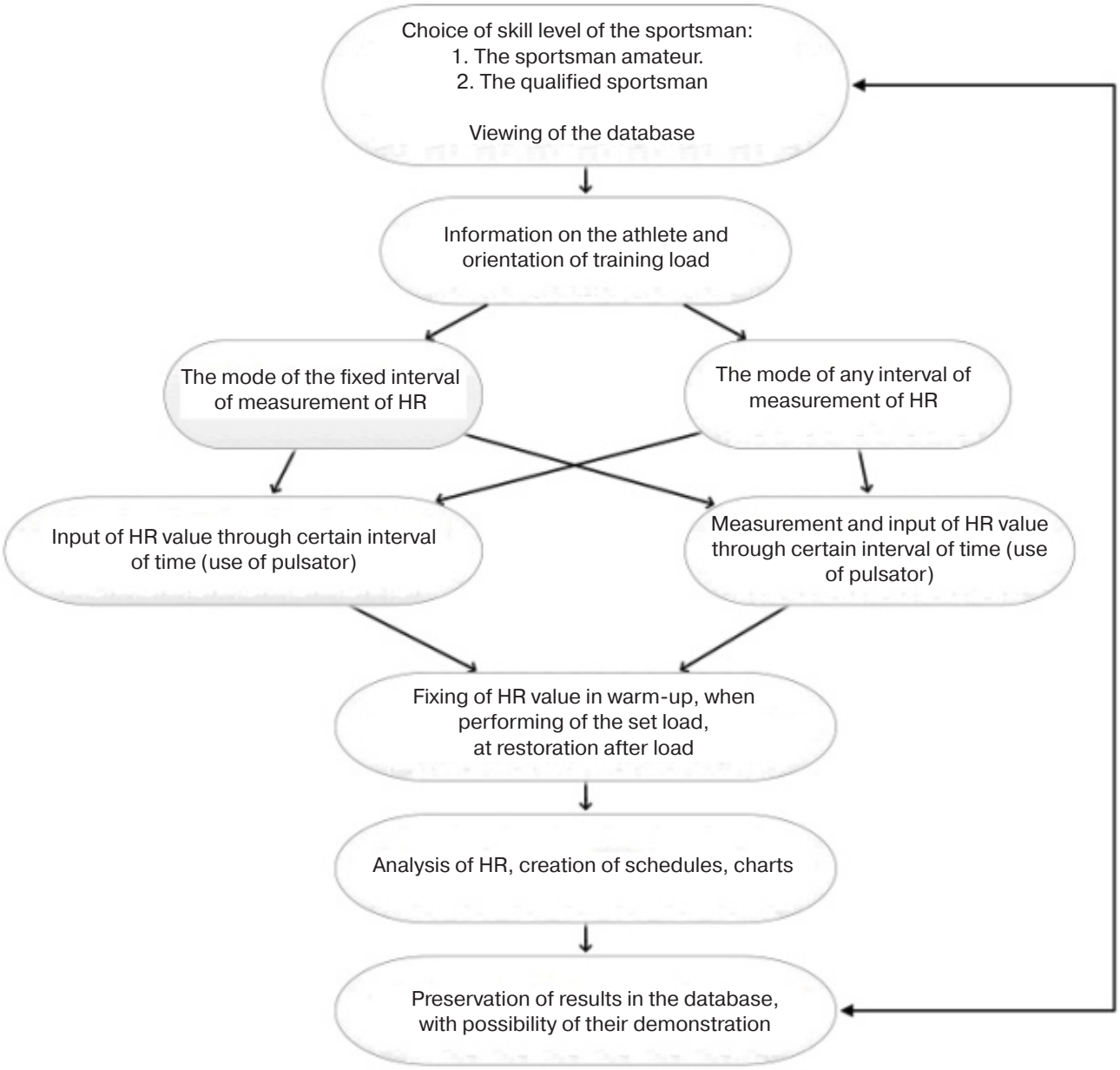
The results, which are presented in this mobile application, and also perception of load by the sportsman, will allow the coach to estimate more objectively reaction of organism of the sportsman to the executed training load and to quickly correct training process.

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



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.
Financing sources. This article didn't get the financial support from the state, public or commercial organization.

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Received: 29.10.2016.
Published: 31.12.2016.

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