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STATISTICAL ANALYSIS OF PHYSIOLOGICAL INDICATORS OF THE LOAD OF THE STUDENTS ON MOUNTAIN-WALKING TOUR

Abstract

This research has been conducted with the goal of using heart rate, based on realistic statistical indicators to show the real intensity of the load of students of Physical Education and Sports Faculty, University in Tuzla, during the organised walking on the mountain Konjuh , within field class for the realisation of subject "Activities in Nature" program. For this purpose, on a sample of five students, all males, aged 21-23, monitoring of the heart rate was conducted using Polar Team System (Polar Electro Oy, Finland) heart rate monitor, whose utilisation is increasingly present in diagnostics, training and rehabilitation.

***Kea words**: diagnostics, heart rate monitor, load zones, sport performances*

1. INTRODUCTION

The purpose of all sports-recreational activities is a positive effect on antropological status of individuals, but these goals can be achieved only if both the intensity and extent of activities are adjusted to needs of individuals. Inactivity itself leads to obesity and development of cardiovascular diseases (Hubert, 1983), particularly of illnesses of the locomotor system (Must, 1999) in all age groups (Vieno, 2005).

The fundamental statistical indicators, with application of Polar Team System, are based on heart rate. Heart is undoubtly the most crucial muscle of body. Functioning of the whole body depends on working of heart, and through this characteristic heart indicates to other important physiological functions as well. For the time being, this is also the only body characteristic that reliably indicates to state of an organism, and can be followed objectively in almost all situations. The load can be determined with high accuracy as physiologic manifestations can be recorded (Hottenrott, 2006).

The objective of this research is monitoring of the load intensity in real conditions during the organised walking tour on the mountain Konjuh using heart rate monitor of the Team Polar System, and familiarisation with the method of controlling the intensity, planning and programming of training load in sports, teaching and recreation by implementing the innovated technologies.

2. METHODS

2.1 Examinee sample

The examinee sample consisted of 5 students of Faculty of Physical Education and Sports at the University of Tuzla, males, chronological age between 21-23 years. All examinees were clinically healthy with no visible body aberrations.

2.2 Sample of variables

With data transmittion from the transmitter through a base station to a computer, and by means of program package of Polar Precision Performance 4SW, the following parameters were determined for each item:

HR_{beats}–total number of heart beats
HR_{min}– minimum value of heart rate
HR_{max} – maximum value of heart rate
HR_{start} – average value of heart rate before load
$HR_{average}$ – total average value of heart rate
HR_1 – average value of heart rate at stage 1
HR_2 – average value of heart rate at stage 2
HR_3 – average value of heart rate at stage 3
HR_4 – average value of heart rate at stage 4
HR_5 – average value of heart rate at stage 5
HR_6 – average value of heart rate at stage 6
HR_7 – average value of heart rate at stage 7

2.3 Measuring equipment and program description

Heart rate is followed and registered via heart rate monitor of the Polar Team System (Polar Electro Oy, Finland). A transmitter integrated on the flexible electrode belt, which is placed around the chest under the chest muscles of the examinee, has detected heart rate and other parameters each 5 seconds during ascent in the time period of 3 hours and 15 minutes, and stored the data in the internal memory. Upon the measurement, transmiterrs were connected to base station, which is responsible for receipt and transmittion of the stored information to a computer via the sofisticated program.

The organised walking tour on the mountain Konjuh has been realised within the field class for the subject Activities in nature. The starting point of the tour was at the bottom of Konjuh Mountain at altitude of 367 meters, while the primary target was on the peak of Bandijerka at altitude of 1209 meters; which was followed by coming down to mountain home Javorje situated at altitude of 930 meters. The ascent has been overcome through 7 stages. Length and duration of partial stages, adequate breaks, and walking speed were adjusted to examinee's sample.

2.4 Methods of data processing

Data processing and analysis have been performed at Faculty of Physical Education and Sports at the University of Tuzla by means of software package of the Polar Precision Performance^{TM} 4SW, and statistical package Statistica 8, with the basic central and dispersion parametres.

3. RESULTS AND DISCUSSION

With data transmittion from the transmitter via the base station to a computer, and using the program package of Polar Precision Performance 4SW the following parameters were determined:

Distributions of individual heart rates (an example for one examinee) in real time were presented on the chart 1. In this manner, it is possible to analyse duration and characteristics of load at each stage of the ascent.

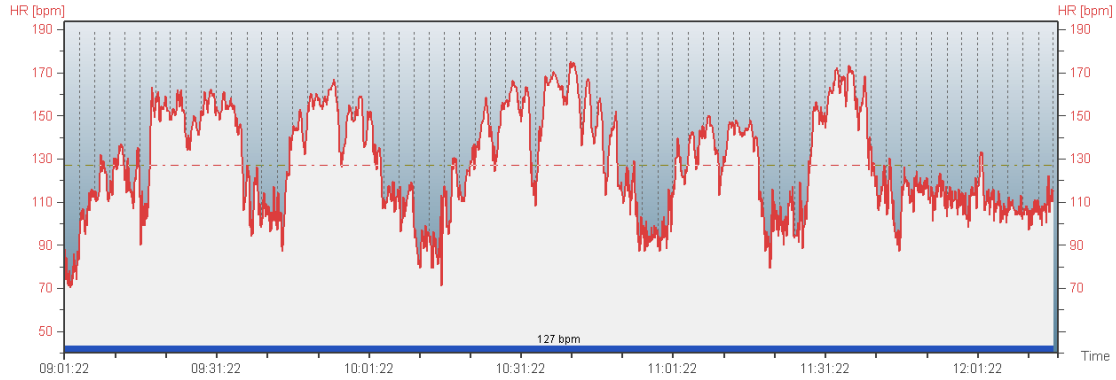

Chart 1. *Heart rate of one examinee in real time*

Detection of heart rates was followed in real time of the ascent in duration of 3 hours and 15 minutes. Of these, for overcoming the ascent by stages 2 hours and 30 minutes were used, while the remaining time was used on rest breaks between the stages. Even with a superficial observation a discontinuous trend in heart rate of the examinee during the ascent can be noticed. Namely, the heart rates experience milder and more sudden increases and falls through the stages, according to physiological load at single stages of the ascent. The average values of heart rate during ascent are graphically shown in broken horizontal projections.
In chart 2, distributions of heart rates of all examinees in real time according to load zones were presented visually, where considerable deviations of heart rates among the examinees can be noticed. The mentioned oscillations are caused by individual adaptations of the examinees to the set loads, which may be attributed to subjective psycho-physical condition, respectively the sport physical preparation.

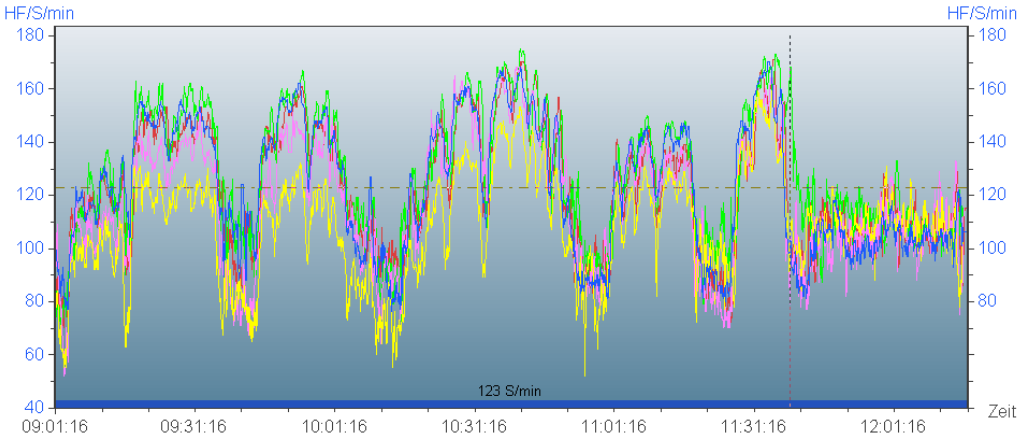

Chart 2. *Heart rates of all examines in real time*

Results that include all relevant statistical and physiological indicators individually for each examinee were presented in corresponding *info-boxes* (Chart 3.).

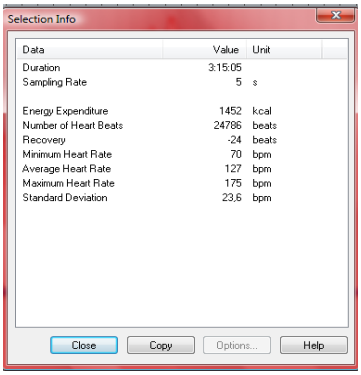

Chart 3. *Info-box of* ***r****elevant statistical and physiological parameters of one examinee*

Of the mentioned indicators, the parameters that enable an insight into the load character and volume, and their analysis, were separated, as follows:

- **HR_{beats}**–total number of heart beats
- **HR_{min}**– minimum value of heart rate
- **HR_{max}**–maximum value of heart rate
- **$HR_{average}$** – total average value of heart rate

With manual approach and using the tools offered by Polar Precision Performance™ 4SW software the following statistical indicators were determined (Chart 4.) for each entity:

- **HR_{start}** – average value of heart rate before load
- **HR_1** – average value of heart rate at stage 1
- **HR_2** – average value of heart rate at stage 2
- **HR_3** – average value of heart rate at stage 3
- **HR_4** - average value of heart rate at stage 4
- **HR_5** – average value of heart rate at stage 5
- **HR_6** – average value of heart rate at stage 6
- **HR_7** – average value of heart rate at stage 7

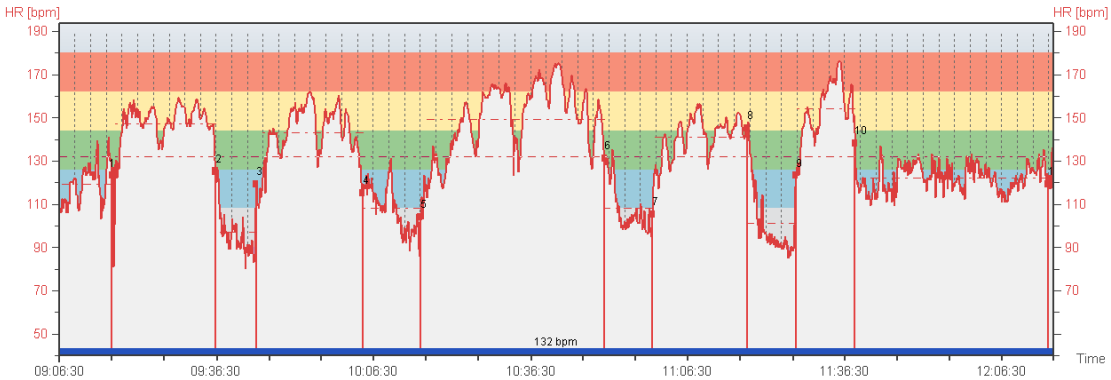

Chart 4. *Manual determination of statistical indicators*

With software package Statistica 8 the basic descriptive statistical parameters of the analysed physiological indicators of load were determined as follows: arithmetic mean (Mean), standard deviation (Std.Dev.), range (Range), minimum (Minimum) and maximum (Maximum) value of results.

Table 1. *Basic descriptive parameters of the researched variables*

Variable	Descriptive Statistics

	Mean	Minimum	Maximum	Range	Std.Dev.
HRbeats	26292,00	25713,00	26909,00	1196,000	550,2136
HRmin	80,60	63,00	91,00	28,000	11,0589
HRmax	183,00	176,00	188,00	12,000	4,8990
HRaverage	134,60	132,00	137,00	5,000	2,3022
HRstart	91,20	82,00	98,00	16,000	6,6106
HR1	119,60	111,00	128,00	17,000	6,9857
HR2	146,40	141,00	155,00	14,000	5,3666
HR3	149,00	139,00	160,00	21,000	8,5732
HR4	153,80	149,00	159,00	10,000	4,3243
HR5	139,60	140,00	146,00	6,000	2,5495
HR6	160,20	154,00	169,00	15,000	5,6303
HR7	125,40	122,00	129,00	7,000	3,3615

The average value of heart rate in all examinees during ascent was 134.4 beats per minute, with real measure of deviation of 2.3 beats per minute. The average minimum pulse is 80.6 beats per minute, while a very high average maximum value of heart rhythm of 183 beats per minute was realised.
It can further be noticed how the values of average parameters of the load increase gradually from the start to completion of the fourth stage of ascent, after which an abrupt fall was recorded, experiencing a sudden rise at the sixth stage and achieving maximum results as a consequence of the highest ascent. According to statistical indicators the final stage abounds in significantly lower values, which correspond to a very light physiological load.
The mentioned oscillations are caused by individual adaptations of the examinees to loads they are exposed to, which can be attributed to subjective psycho-physical condition, respectively the sport strength and conditioning. For all participants, the set requirements represented a moderate and high functional stimulus and caused positive adaptation processes that can be expected according to individual training zones.
This information should be considered orientationally, not as a fact for planning and programming the training process, having in mind individual characteristics of each examinee.

4. CONCLUSION

Heart monitoring enables a quality approach to analysis, i.e. offers an insight into a real load that kinesiologic treatments represent for each individual. The feedback illustrates the effects of the set programs and opens the space for optimum planning and programming of training contents in accordance with the needs of individuals, for the purpose of development of sports performances, which completely justifies implementation of heart rate monitor in sports, teaching and recreation.

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