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Comparison of heart rate during the specific load and training match in boxing

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Abstract
The aim of the work was to identify the immediate effect of the specific training load and training match measured in boxing in terms of heart rate in order to assess the validity of the designed load as an appropriate training tool. Our research group consisted of 45 probands divided into three groups of 15. The average age of the women group was 21.7 ± 1.8 years, body weight 62.1 ± 7.5 kilograms and body height 169.60 ± 7.17 centimeters. In group of men the average age was 22.27 years ± 1.49, body weight 74.93 kg ± 9.88 and body height 180.87 cm ± 8.21. In a group of boxers was the average age 19.07 ± 2.52 years, body weight 71.47 ± 13 and body height 179.93 ± 8.19 cm. We monitored the heart rate measured by SUUNTO. The designed specific load was conceived as the conditioning equivalent to boxing match of 3x3 minutes and it consisted of repeated performing the strength-speed sequences which are the combinations of push-ups and maximal effort movement in approximate duration 5 seconds. The data were evaluated by the descriptive statistics, compared by analysis of variance two-factored with replication. The validity of load was reviewed by ICC correlation coefficient. The specific load produced the immediate statistically significant effect of increasing the average heart frequency in the individual rounds $p<0.01$, where boxers reached the highest values $p<0.01$. The training match caused similar immediate effect as the specific load with the increasing heart rate frequency between the rounds $p<0.01$. In the case of heart rate the immediate effect of training match and specific load was statistically significant and similar on 80.6% The results pointed to the increasing heart frequency. The validity of our designed specific load as the appropriate training tool has been proven. Results of this work contribute to the training quality improving and for improving the performance of boxers.

Keywords: Boxing, specific load, training match, immediate effect, heart rate

Introduction
Nowadays, martial arts gaining the popularity. High level of sport performance requires an effective adjustment of the training process, which implies a strong knowledge of the structure of sport performance. Our subjective opinion is that the greatest reserves in boxing match according to fitness level are special endurance, persistnace in explosive movements. From the lower level to the top competitions we can notice the fact that guys towards the end of the match, figuratively speaking are „running out of steam“. However, in practise we are lack of suitable training device that could significantly improve this ability, while clearly defined the course of the load in terms of fatigue. The theoretical recourse for creating a specific training load affecting just special endurance can be found in research [9] which elaborated 3 minutes drill coincides with the duration of the round in competition match. They recommend the use of complex multi-joint exercises weighlifting charakter [10] and others focused on self-weight exercises [9]. Load and rest intervals can be then adjusted according to analysis[14]. The basis of the load may be a push-up exercise commonly used in both, the trainig process and diagnostics in combination with quick movement [3, 11, 16], which suits us in terms of time [14] as well as involving similar muscle groups as in boxing [4]. In order to be able to recommend physical activity programs weather in the training process or as a diagnostic tool, we need to know the impact on the body and compare it to the match load. A similar methodology has been developed in the research [13]. With immediate effect, draw attention to the incrase in heart rate in specific boxing load and its similarity during the match load [5-8, 12, 13]. The aim of the work was to identify the immediate effect of a specific trainig load and boxig training match according the heart rate and to compare them in order to assess the validity of the proposed load as a suitable training programe.

Methods

The research group consisted of 45 probands divided into three groups of 15 persons. The groups of men and women consisted of students of the Department of Physical Education and Sport, Constatntine the Philosopher Univerzity in Nitra, average fitness level with individual differences between individual students. The average age of women was 21.7 ± 1.8 years, body weight 62.1 kg ± 7.5 and height 169.60 cm ± 7.17. the average age of men was 22.27 years ± 1.49, 74.93 kg ± 9.88 and 180.87 cm ± 8.21. Boxers file consisted of probands from boxing clubs BCS Nitra and PRO box Nitra, the average age was 19.07 ± 2.52 years, body weight 71.47 ± 13 kg and height 179.93 ± 8.19 cm. Each of the tested boxers had at least one competition match and devoted to boxing 3.13 ± 1.8 years.

The Training Match

The training match had the same duration as the 3x3 minutes match with 1 minute rest between the rounds and took place in an imitated ring which dimensions were identical to the classic boxing ring. The conditions were adapted to follow the course as much as possible.

Specific Load

The load was coincident with the boxing match – 3x3 minutes with 1 minute rest between the rounds and was conceived as a conditioning equivalent to the match. It consisted of repeated performance of strength-speed sequence which is a combination of push-ups and motion with maximum effort over a period approx. 5 seconds. There was a boxing figure with 150 cm height on the ground with a base of 60 cm diamater and a fixed FiTRO agility plate next to it. The speed-strength sequence starts from the stand. Proband does the push-up with stretched or slightly flexed hands with one hand facing the plate. Then proband stands up and runs around the figurine and at the opposite side performs the other push-up with stretched or slightly flexed hands with other hand facing the plate – closing the sequence. Throughout the whole sequence the proband is trying to reach the highest intensity and performs it with the maximum effort (fig. 1). the second push-up in sequence is followed by a rest which each proband manages individually according to its current feelings and performance. The rest is followed by another sequence from the side where the porband ended the previous one. In this case the side movement around the figurine is performed on the other leg. This created a short-interval, high-intensity load.

Pic. 1: Progression of sequence execution

Suunto

The heart rate was recorded by using a SUUNTO device that receives wireless signals from Suunto heart rate monitor up to 100 meters (combination of several devices can cover a larger space). It displays the heart rate of athletes on the monitor in real time, captures change severy second, gives information about each athlete´s perfomance and allows them to manage each team member individually and adapt the training to the current situation. The SUUNTO team manager device consist of PC, Suunto receiver and chest band.

Statistical analysis

We use descriptive characteristics such as mean (M), standart deviation (SD), maximum (max), minimum (min) to present the research data. We use ANOVA (two -factor with replication) analysis to compare the files. Relationship tightness and validity were assessed by ICC correlation coefficient. Confirmation or rejection of established hypotheses was expressed on 5% and 1% significance level.

Results

The immediate effect of specific load and training match on heart rate parameters we assessed maximum and average values. The highest values were achieved in the group of boxers, while in group of men and women the values were similar (tab.1)

Table 1: Maximum and average heart rate in pulse per minute during specific load and training match per round.

	Max			Mean		
SL	**women**	**men**	**boxers**	**women**	**men**	**boxers**
I. Round	178.27	181.00	188.00	166.32	171.59	175.52
II. Round	182.33	183.60	189.87	174.19	176.10	182.74
III. Round	184.87	183.60	191.33	175.95	176.42	183.27
TM	women	men	boxers	women	men	boxers
I. Round	178.33	182.27	185.07	165.97	170.14	175.24
II. Round	184.67	186.87	188.60	176.00	179.02	181.44
III. Round	186.27	189.20	192.00	177.65	180.57	184.33

Notes: SL – specific load, TM – training match, Max – maximum heart rate values, Mean- average heart rate values

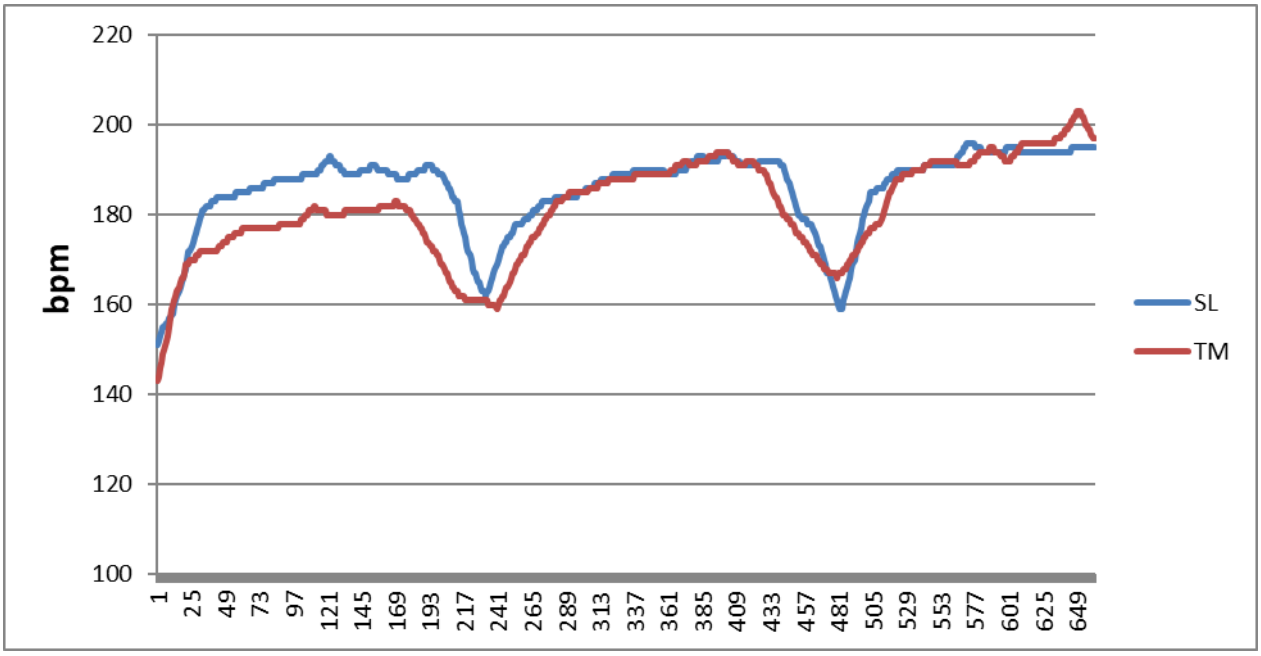

Fig 2: Course of heart rate during specific load and training match of individual proband. SL – specific load, TM – training match

Comparing the maxium heart rate in a specific load during individual rounds, we can conclude that the research gorups differed significantly from one another F (2.126) = 8.32; $p<0.01$, and a statistically significant increase of heart rate during rounds F (2.126) = 6.02; $p<0.05$. Comparing the maximum heart rate in training match for individual round, we can conclude that the groups differed significantly from each other F (2.126) = 4.23; $p<0.05$ and there was also a statistically significant increase in heart rate during rounds F (2.126) = 7.72; $p<0.01$ (fig. 3).

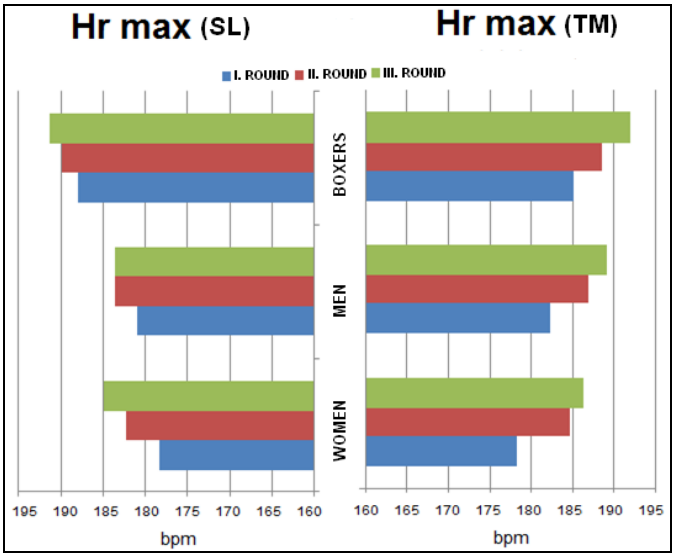

Fig 3: Maximum heart rate values in individual round during specific load and training match. SP – specific load, TM – training match, bpm – beats per minute

Similarity coefficients were found for maximum heart rate values

Overall 80.60% (ICC = 0.896, 95% CI: 0.735 – 0.858, *p*< 0.01)
I. Round 80.50% (ICC = 0.805, 95% CI: 0.672 – 0.888, *p*< 0.01)
II.Round 83.50% (ICC = 0.835, 95% CI: 0.719 – 0.905, *p*< 0.01)
III.Round 76.70% (ICC = 0.767, 95% CI: 0.612 – 0.855, *p*< 0.01)

Comparing the average heart rate in a specific load over the individual rounds we can conclude that the groups differed significantly from one another F(2.126) =7.43; $p<0.01$, and there was also statistically significant increase in heart rate during rounds F(2.126) = 6.63; $p<0.01$.

Comparing the average heart rate in a training match over the individual rounds we can conclude that the groups differed significantly from one another F(2.126) =7.53; $p<0.001$, a takisto došlo aj ku štatisticky významnému nárastu srdcovej frekvencie F(2.126) = 17.99; $p<0.001$ (fig. 4).

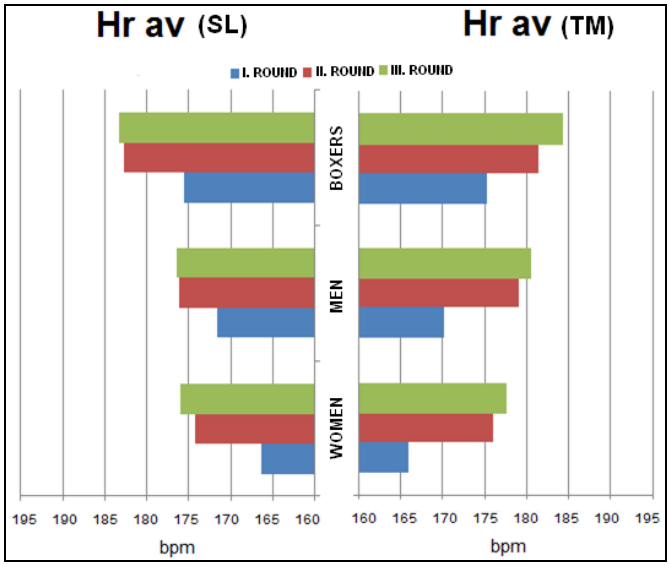

Fig 4: Average values of heart rate in individual rounds during specific load and trainig match. SP – specific load, TM – training match, bpm – beats per minute

Similarity coefficients were found for average heart rate values

Overall 81.3% (ICC = 0.813, 95% CI: 0.747 – 0.863, *p*< 0.01)
I. Round 71.60% (ICC = 0.716, 95% CI: 0.538 – 0.834, *p*< 0.01)
II.Round 85.20% (ICC = 0.852, 95% CI: 0.746 – 0.916, *p*< 0.01)
III.Round 80.60% (ICC = 0.806, 95% CI: 0.673 – 0.888, *p*< 0.01)

Discusion

If we directly focus on the immediate effect of specific load and training match on heart rate as a modeled perfomance parameter, we assume an increase between rounds. This fact has been proven. The highest values was reached by boxers,

which we can explain by the fact that they are adapted on this kind of load and they are able to keep the intensity on higher level for longer. In this case in a group of men we may notice the development of heart rate under a specific load where there is no increase between the second and the third round, which confirms our belief that they are not ready for this kind of load, although some may be physically quite well prepared. However, they are students of physical education, they are not able to upgrade their performance as boxers and remain at the same levels. We did not notice this trend only in the group of men but also some boxers at a lower performance level „burned the pace" at the beginning of the load and there was a significant decrease in performance between the rounds. There was no significant differences during the 1 minute rest in heart rate neither between the rounds nor groups and in this case we should discuss if this parameter can shows the level of physical fitness. We monitored maximum and average values and there was increase in both cases. We can say that the average values are lower approx. 10 pulses than the maximum, but the correlation of the values proved to be 94.7% in the training match and 96.5% in the specific load. For this reason it is sufficient to observe only one of these values in the future. If we compare the achieved heart rate values in a specific load, in our research the probands ranged from 180 to 195 pulses. Author [15] also shows similar values in 3x3 minutes load from the first to the third round in the interval from 180 to 195 pulses and the average values were approx. 10 pulses lower. In a research [1] monitored the heart rate response during the work with punch equipment and expressed the values as a percentage of the maximum which he had previously detected with a treaded load on the treadmill. The values were in the range above 90% which indicate that the heart rate in boxing exercises is close to the maximum values. With a specific kickboxing load of 3x2 minutes showed an increase in heart rate between rounds and values ranged from 184 to 190 pulses [13]. In our study the highest heart rate was 207 pulses, where [6] indicate 204 pulses as a response to specific boxing exercises. During the sparring or training match [5-8, 12, 13] indicate the average heart rate values approx. 190 pulses and maximum over 200 pulses, which is also comparable to our research. In a research [13] stated that there was no statistically significant differences between the heart rate values comparing the training match and the proposed specific load, which we can agree with. In our case we found a match approx. 80% at 1% statistical significance. We can conclude that the specific load we suggested relating with heart rate is a high copy of the training match.

Conclusion

We can recommend this designed specific load as a useful training tool for the development of special endurance. From the viewpoint of periodization, it can be used in the intensification, transformation and into the pre-competition period as a transfer of the fitness potential into the specific movement performance. The power-speed sequence itself presents by its simplicity big potential for the enrichment of the training process.

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