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The effects of sex and changes of game rules on the intensity of inner loads during small-sided games in four on four basketball

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Abstract
Small-sided games are very common conditioning method within sports training, especially in team sports. The practical part of the thesis deals with the measurement of inner load during 4 on 4 games with the modification of basketball rules. The thesis compares physiological intensity of exercise between males and females. The basic monitored parameters are the average heart rate, the blood lactate threshold and the subjective assessment with the Borg's scale (RPE). The results are also compared with the results of foreign expert sources. Data was obtained by project International Visegrad Fund No. 11320057.

Keywords: basketball, small sided games, heart rate (HR), lactate threshold (LT)

Introduction

The research was focused on a comparison of inner (physiological) loads between male and female players during small-sided games (further only SSG). SSG are widely used in training units not only for increasing physical conditioning but also to improve decision making and technical skills under the pressure during competition (Hill-Haas, Dawson, Impellizzeri & Coutts, 2011).

This topic is still not fully researched in these days. There are some studies which research inner loads of different SSG but the results usually differ. There has been no systematic study yet which would research physiological loads of SSG in basketball (Castagna et al., 2011). There are no further connections with competition matches in terms of monitoring training effects of SSG (Stone & Kilding, 2009). That is also the reason why 4 on 4 games were chosen to research, if those game variations are appropriate for conditioning in basketball.

Many authors mention the benefits of SSG (Stone & Kilding, 2009; Castagna et al., 2011), but the question of the intensity is not clearly stated (Hill-Haas et al., 2011).

Aguiar et al. (2012) state that if we want to achieve high quality performance in some sport it is important to have similar training stimuli like in the competition. That is why are SSG included more and more into trainings of different sports. That is confirmed by Clemente et al. (2012), who say that we can by this way maximize the benefits of the training process. Sampaio et al. (2009) mention that SSG are in many cases used also in basketball because

players are more involved into game and besides the benefits above, players are also more responsible for the basic offensive and defensive actions.

The aim of the research was to evaluate the impact of the sex and changes of rules on the inner load of male and female players during 4 on 4 SSG.

Material and methods

On the research participated 32 probands (16 women, 16 boys). The average age of both groups was 18,44 ± 2,83 years. Women are members of elite Sports Club of Palacky University (SK UP Olomouc). Their average age is 20,63 ± 2,45 years. The average height is 179,75 ± 7,65cm and average weight is 69,25 ± 9,30 kgs. The male part of the research group consisted of players under 19 years (U19). They are members of Basketball center for youth (BCM Olomouc). The average age of those players is 16,25 ± 0,46 years. The average height is 185,25 ± 7,72 cm and the average weight is 80,16 ± 12,78 kgs. All monitored players agreed to participate on the research, they were told about the aims and conditions of the research and their participation was voluntary and they could leave the research anytime.

There was monitoring of heart rate and measurement of blood lactate threshold used to determine inner load of participated players. Sport Tester Team Polar was used to monitor heart rate. Collected data were transformed into computer and were evaluated by software Polar Precision Performance SW. The Lactate Scout + device was used to measure blood lactate threshold.

All measurements were done in the Hall of Sports of Palacky University. The games were played on the field with size 28 x 15 m. The whole research was recorded on a videocam, which covered all playing field. There were 3 different SSG monitored. The time of exercise and the time of rest was still the same but game rules were modified, which should cause higher intensity of exercise and also higher inner load.

The SPSS statistical software (17.0 version; SPSS Inc., Chicago, IL) was used for statistical processing. Due to low number of probands in the research group there was non-parametric Man-Whitney U test, Kruskal-Wallis ANOVA and Dunn's non-parametric comparison used. The results were processed on the significance level $p<0,05$.

Results and discussion

The aim of the research was to evaluate the impact of the sex and changes of rules on the inner load of male and female players during 4 on 4 SSG.

The highest inner load during SSG 4 on 4 with rules modification was measured on boys, when the average heart rate was 180,43 ± 6,99 beats per minute (b.p.m) during the third game variation. Women gained the highest inner load during the first game variation, when their average heart rate was 172,06 ± 8,43 b.p.m.

Significant differences between women and boys were found only in the third game variation ($p=0,00$), when women had the average heart rate only 160,81 ± 12,25 b.p.m while boys gained the highest inner load of all game variations.

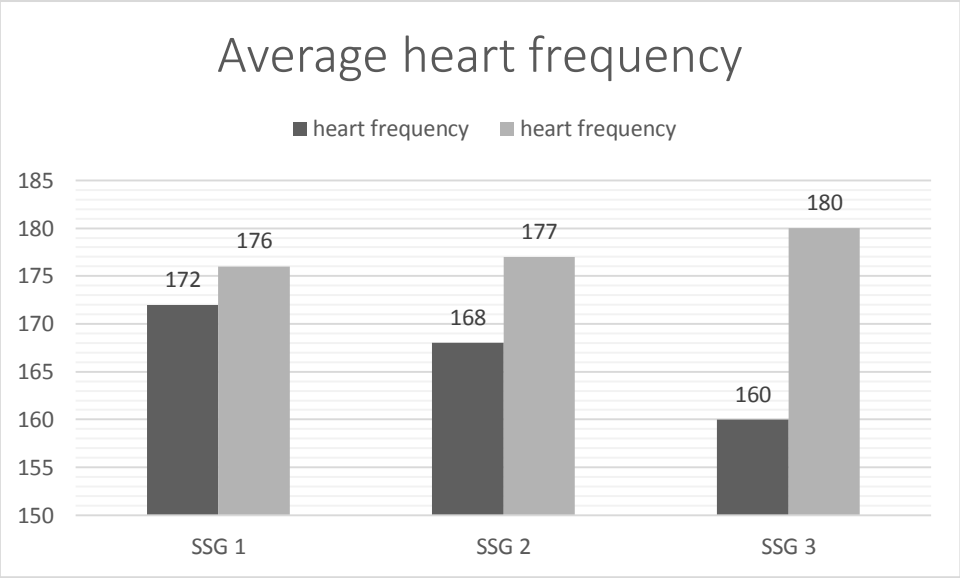

Figure 1. The average heart frequency during different types of small-sided games in comparison between sexes (beats per minute)

The highest average blood lactate threshold was measured during the second game variation in boys, when the values were 11,54 ± 5,27 mmolxl^{-1} in average. Women gained the highest value again during the first game variation, when the inner load was 7,05 ± 3,97 mmolxl^{-1} in average.

Significant differences between women and boys were found in the average lactate threshold during the second game variation (p=0,00), when the boys gained significantly higher average lactate threshold - 11,54 ± 5,27 mmolxl^{-1}.

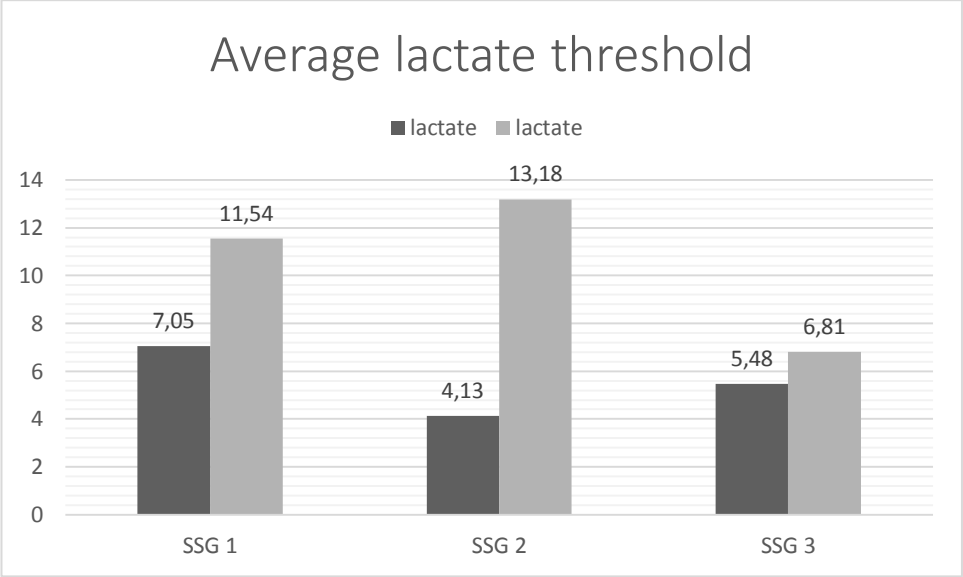

Figure 2. The average lactate treshold during different types of small-sided games in comparison between sexes (mmolxl^{-1}**)**

There were Borg's scale (from 1 to 10) used to evaluate subjective inner load. The results had not showed any significant differences between women and boys (p=0,36). There are also no significant differences among the different game variations in women (p=0,14) so also in men (p=0,37).

Apart from monitoring heart rate, blood lactate threshold and usage of Borg's scale there were also made a record of each measurement. The purpose of the record was evaluation of modified SSG in terms of technical skills. The aim of this part was to consider if the game rules changes make sense and there is no too high number of losses of the ball or the game is too much interrupted. The number of shoots and ball losses was almost the same during all game variation, so we can say that those game modifications are not influencing players' technical skills and that the research group was technically enough equipped to manage those modifications well.

The study of Matthew & Delextrat (2009) focused on classic basketball match (5 on 5) found that the average heart rate is about 165 ± 9 b.p.m. (89,1 % of maximum heart rate) in women. They also found that the average blood lactate threshold was 5,2 ± 2,7 $mmolxl^{-1}$ (55,9 % of the maximum).

Narazaki et al. (2008) during their research of preliminary basketball match measured the average lactate threshold 3.2 ± 0.9 $mmolxl^{-1}$ in women and 4.2 ± 1.3 $mmolxl^{-1}$ in men. The results from our research during 4 on 4 game variation are according to mentioned authors higher.

McCormick et al. (2012) during the research of 5 on 5 game during match measured almost the same values like Matthew a Delextrat (2009) and those are 165 ± 9,6 b.p.m. Sampaio et al. (2009) researched the 4 on 4 game and found average heart rate 164,7±16,2 b.p.m. The results of our research showed higher values for both groups (women and boys). From the results we can say that our modified SSG are more demanding than competition matches. And we can also say that those SSG variations of 4 on 4 basketball are suitable for conditioning in basketball training with many benefits which are mentioned above.

Conclusions

The research is comparing inner (physiological) loads of basketball male and female players during 4 on 4 games with changes in different basketball rules.

The research group consisted of male and female basketball players from Olomouc region. The female players are team members of SK UP Olomouc and their average age is 20,63 ± 2,45 years. Their average height is 179,75 ± 7,65cm and their average weight is 69,25 ± 9,30 kilos. Male players are members of BCM (basketball center of youth) Olomouc and they are competing in the league of youth U19 (under 19). The average age of those players is 16,25 ± 0,46 years. The average height of the players is 185,25 ± 7,72 cm and the average weight 80,16 ± 12,78 kilos.

In the research was used a modern training method which is called small-sided games (SSG), and a modern method for measurement of subjective perception of exercise intensity, called Borg's scale(RPE). The highest intensity of inner load during SSG was during the 4 on 4 game with 14 seconds time-limit for shooting and with a change of playing side after each shoot. This was the most demanding game variation by male players, while females gain the lowest load during this SSG. The female players gain the highest load according to heart rate during the game 4 on 4 with classical basketball rules.

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