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Examining the Effect of Fatigue on Shooting Accuracy in Young Basketball Players

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ABSTRACT This research was carried out to examine the effects of fatigue, which result from high-intensity exercises on shooting accuracy in young basketball players. Thirteen male basketball players (15.08±0.64 years) voluntarily participated in the present research (AAHPERD) wherein a basketball shooting test was conducted in order to measure shooting skills of basketball players. The Yo-Yo Intermittent Recovery Test-Level 1 (YYIRT-1) was used in order to create fatigue among basketball players. Heart beat rate of the players were recorded with heart beat monitor. There was a significant difference between pre-test (STSpre=12.62±3.02) and post-test (STSpost=10.54±2.96) values of shooting test scores (STS) ($p<0.01$). Heart rate before the shooting test before physical exertion was found as HRpre=122.31±17.57 bmp, and heart rate average at fatigue level after running test was HRpost =173.77±17.09 bmp. Average HR showed that players conducted shooting test at 87.39± 6.16 percent of the HRmax. Consequently, shooting accuracy skills of young basketball players deteriorate when they are exposed to fatigue level physical exertion.

INTRODUCTION

Sports-related fatigue is defined as the physical, physiological and psychological changes resulting from constant and intense exercise, which causes sportive inefficiency in motor and technique skills (Edwards 1983; Nadel 1985; Rahnama et al. 2003). Many sports branches require resistance to intense and long-duration fatigue, and maximal efficiency during the implementation of motor tasks and some techniques. Basketball is a branch of sports in which game performance of players is affected by the physical condition and fatigue rate of players (Erculi and Supej 2009).

In basketball, aerobic metabolism is used in terms of time, and anaerobic energy metabolism is used in terms of game characteristics, and players perform high intensity activities, such as jumping, turnovers, and sprints, and low intensity activities, such as walking, standing, and jogging. Therefore, the game requires a physical exertion in which high intensity short-term activities are repeated for 40 minutes with intermittent short recovery periods. Previous researches on basketball found that players covered an average of 4500-6000 meters distance, and they needed to move at a velocity around 2m/s depending on the position, and twenty to thirty percent of the energy players used was aerobic, and seventy to eighty percent as anaerobic energy (Tomlin and Wenger 2001; Abdelkerim et al. 2007; Castagna 2008). It was reported that players performed low intensity activities during the sixty percent of the duration of a game, and they performed high intensity activities during fifteen percent of the game, average HR was 169±9 beats per minute, and this was eighty-nine percent of the HRmax. Additionally, players performed at eighty-five percent of the HRmax for seventy-five percent of the basketball game duration. It was also found that energy used during the game was met through glycolysis with a blood-lactate concentration around 6-7 mM (Mc Innes 1995).

Besides these, as the players move on to elite levels in basketball, they experience an improvement in their technical skills (dribbling, passing, shooting and so on) (Brandao et al. 2003). However, fatigue caused by physical exertion is one of the most important factors affecting technical skills during the game. Previous researches reported that some technical skills deteriorated due to fatigue, and the extent of this deterioration varied according to the level of fatigue (Ivoilov et al. 1981; Lyons 2006; Mulazimoglu 2012). This research was carried out to examine the effect of fatigue suffered due to high-intensity exercise on shooting accuracy among young basketball players.

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METHODOLOGY

Participants

Thirteen male basketball players in U-16 category (age=15.08±0.64 years) voluntarily participated in the present research. The University Ethics Committee approval for the study's experimental procedures was obtained along with written informed consent. The principles outlined in the Declaration of Helsinki were also followed.

Measures

AAHPERD Basketball Skill Test, speed spot shooting test was conducted in order to measure the shooting skills of basketball players. AAHPERD Basketball Skill Test includes basketball specific tests, such as dribbling, passing, speed spot shooting and defensive moves. Validity coefficient for all parts of the test was reported as .65, .95. Reliability coefficient was found as .84, .97 with the test-retest reliability test (Strand and Wilson 1993). The Shooting Test part of this test was considered appropriate to measure shooting skills of young basketball players for the present research.

The Yo-Yo Intermittent Recovery Test-Level 1 (YYIRT-1) was used in order to induce fatigue among basketball players. YYIRT-1 is a test made up of running at increasing velocities, with 10 seconds recovery periods conducted on a field of 2*20 meters (Bangsbo 1994; Krustrup et al. 2003). The HR values of the players were recorded using a heart rate monitor (Polar RS800CX monitor, Polar Electro OY, Kempele, Finland).

Procedures

In accordance with the experiment design of the present research, basketball players conducted a speed shot test after a 10-15 minute warm-up without any physical exertion. Before physical exertion, their heart rate (HRpre) and Shooting Test Scores (STSpre) were recorded. Then participants conducted YYIRT-1 run test for a physical exertion to induce fatigue. At fatigue level, players' YYIRT-1 levels and heart rate (HRpost) were recorded. Following the recording, a shooting test was conducted. Shooting test scores were recorded (STSpost) following which the workout ended.

Analysis

Pre-test and post-test heart rate, and shooting test scores of players were compared statistically with paired sample t-test. In order to clarify the data, the findings are presented in tables and graphs. The significance level for the statistical packaged software used was taken as 0.05 for data interpretation.

RESULTS

Thirteen male basketball players in Stars (U-16) category, who had an average 4.46±1.05 years of experience (age=15.08±0.64 years, height= 175.38±8.55cm. weight=70.54±16.10kg.) voluntarily participated in the present research.

The researchers found that players reached the average level of 19.38±2.76 and they covered a distance of 775.38±110.20 m in YYIRT-1. Rested heart rate average was found as HRrest=90.69±9.83 bmp and maximal heart rate was found as HRmax= 198.54±7.92 bmp. Heart rate before the shooting test before physical exertion was found as HRpre=122.31±17.57 bmp, and heart rate average at fatigue level after run test (YYIRT-1) was HRpost =173.77±17.09 bmp. Average HR showed that players conducted shooting test at 87.39± 6.16 percent of the HRmax (Table 1).

Table 1: Descriptive statistics for young basketball players

Variables	*N*	*Min.*	*Max.*	*Mean*	*SD*
Age (year)	13	14	16	15.08	.64
Height (cm)	13	157	184	175.38	8.55
Weight (kg)	13	45	116	70.92	16.10
Experience (year)	13	3	7	4.46	1.05
HR rest	13	78	108	90.69	9.83
HR max	13	183	210	198.54	7.92
HR pre	13	94	144	122.31	17.57
HR post	13	141	200	173.77	17.09
HR post%	13	74.74	95.41	87.39	6.16
YYIRT-1 (shuttle)	13	16	24	19.38	2.76
YYIRT-1 distance (m)	13	640	960	775.38	110.20

Abbreviate: HR= Heart Rate, pre=before physical exertion, post= after physical exertion, YYIRT-1= Yo-Yo Intermittent Recovery Test Level-1.

The shooting test score at rested condition was 12.62±3.02 and average of the scores was

Table 2: Statistics for comparison of basketball shooting test scores

Paired	*N*	*Min.*	*Max.*	*Mean*	*SD.*	*t*	*df*	*P*
STSpre	13	8	17	12.62	3.02	5.196**	12	.000
STSpost	13	7	15	10.54	2.96			

**P<0.01; *Abbreviate:* STS pre=shooting test score before physical exertion STS post= shooting test score after physical exertion at fatigue level

10.54±2.96 at fatigue level. The researchers found a significant difference between pre-test and post-test shooting test score averages ($t_{(df=12)}$=5.196; p<0.01) (Table 2).

Average HR of the players before post-test was seventy-five to ninety-five percent of the HRmax (HRmax=198.54±7.92 beat/min). These values showed that players' shooting skills were tested at sub-maximal of their fatigue level (Table 1). The proximity of average HR at fatigue level created with physical exertion (HRpost) to HRmax was remarkable.

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DISCUSSION

Findings obtained in the present research showed that the shooting accuracy of young basketball players was affected negatively by fatigue. The findings of this research were in agreement with the findings of previous researches on the relationships between fatigue and some technical skills in basketball (Ivoilov et al. 1981; Lyons et al. 2006; Erculi and Supej 2009; Mulazimoglu 2012).

The average HR of the 13 male basketball players in U-16 category (age=15.08±0.64 years, height=175.38±8.55 cm., weight=70.54±16.10 kg) who participated in the present research at various fatigue levels (HRrest= 90.69±9.83; HRpre=122.31±17.57; HRpost= 173.77±17.09; HRmax= 198.54±7.92 bmp) revealed the effects of physical exertion on HR. HR, calculated in accordance with the HRmax, showed that players conducted shooting test at HRpost(%)= 87.39±6.16 stress level.

Erculj and Supej (2009) reported that increasing physical exertion (HR=90.7% HRpeak; Lactic Acid ≤ 4.5 mmol.L^{-1}) affected shooting accuracy among elite basketball players (age: 26.5). Lyons et al. (2006) conducted a research on the effects of fatigue on passing accuracy among elite and non-elite basketball players, and they found that there is a significant difference between passing scores at seventy percent medium and ninety percent high fatigue levels (p<0.01), and the deterioration in passing accuracy due to fatigue among non-elite players was higher than among elite players. Mulazimoglu (2012) reported in his research conducted on basketball players using a 20-meter shuttle run that there was a significant difference between shooting test scores obtained at medium intensity (13.92±2.78 points), and high intensity (10.00±4.20 points) fatigue (p<0.01).

The findings of this research were in agreement with the findings of previous similar researches on various fatigue levels, heart rate before and after physical exertion was found as respectively, HRpre=122.31±17.57, HRpost =173.77±17.09 bmp (87.39± 6.16% HRmax) (Ivoilov et al. 1981; Lyons et al. 2006; Erculi and Supej 2009; Mulazimoglu 2012). In the present research, the researchers found a statistically significant difference between shooting test scores before (STSpre= 12.62±3.02 points) and after (STSpost=10.54±2.96 points) physical exertion ($t_{(df=12)}$=5.196; p=0.000) (Table 1).

CONCLUSION

The HR of the players who are exposed to physical exertion has an increasing trend, and their shooting accuracy deteriorates when they are at fatigue level. Therefore, it is important for basketball trainers to know at what level basketball specific skills of players change at fatigue level. In accordance with the findings obtained in this research, in line with the physiological needs, basketball players should be trained better in order to minimize the effects of fatigue of technical skills, and to maximize game performance. Additionally, shooting trainings can be conducted at aerobic and anaerobic fatigue levels during technical shooting training among young basketball players. Information about the levels at which each player is affected by fatigue can help trainers formulate better game strategies.

Practical Applications

If basketball coaches can accurately determine the critical point in the fatigue accumulation (percentage of HRmax) among young players according to their individual features, and so increase their endurance levels with target trainings, they can minimize the deterioration in the technical skills. By doing so, they can support the players' present and future achievements. Additionally, this will allow for proper inclusion within a player's techno-motoric training program, improving overall effectiveness. For example, both anaerobic physical exertion and technically accurate passing or shooting may be achieved.

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