ENDURANCE PERFORMANCE IN BASKETBALL: COMPARISON BY AGE CATEGORIES

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Abstract

The aim of this study was to investigate the endurance performance in the male basketball players according to age categories. Totally 89 male healthy basketball players (age between 10-16 years) were voluntarily participated in this study. The age categories are determined as under 12 age (U12) novice, under 14 age (U14) little, under 16 age (U16) youth and under 18 age (U18) junior. 20 m shuttle-run test applied to determine the endurance performances of the subjects. VO_{2max}, number of laps and total distance parameters are examined. It has been found that endurance performance increases with age. However, this increase was determined to be significantly different between the age categories ($p<0.05$). Although it was determined that endurance performance increased with age in male basketball athletes, there is no significant difference in endurance performance between U12 and U14. It is recommended to examine the lack of difference between novice and little teams in terms of adolescence and/or transition to adolescence.

Keywords*: endurance, basketball, $VO_{2max,}$ age category*

Introduction

It is indispensable for success in all sports disciplines to base athletes' condition and physical fitness on the physiological demands unique to each sports branch (Bağcı, 2017; Balčiūnas, Stonkus, Abrantes, & Sampaio, 2006). Basketball, as is known, is a team sport that has been played since the late 1800s and necessitates endurance, speed, agility, and strength. Competitive basketball is an intermittent high-intensity physical activity that necessitates a well-developed aerobic and anaerobic fitness (Castagna, Impellizzeri, Rampinini, D'Ottavio, & Manzi, 2008). Although basketball performance is thought to be primarily based on the players' anaerobic abilities, high aerobic fitness is also important for high performance (Stojanovic et al., 2016; Stone & Steingard, 1993). During the competition, athletes perform repetitive sprints, jumps, slow-moderate-high intensity running, walking, and stopping movements (Ben Abdelkrim, El Fazaa, El Ati, & Tabka, 2007; Matthew & Delextrat, 2009). For this reason, a basketball player must train several physical fitness components. Thus, the athlete engages in various training modes (such as strength, anaerobic power, and endurance) simultaneously (Chittibabu & Akilan, 2013). Measurement and follow-up of physical and physiological performance that varies with age are essential for either individual and team success (Aksen Cengizhan, 2015; Gürses, Oskouei, Işık, & Ersöz, 2017; Sarlis & Tjortjis, 2020).

Even though age categories are just two years long, this range has a significant effect on the majority of an athlete's functional capacities (Coelho E Silva et al., 2010; Gürses et al., 2017; Tansel, Salci, Yildirim, Kocak, & Korkusuz, 2008) and in this period, it is very important to know and follow the motoric characteristics and capacities of the athletes. Therefore, the purpose of this study was to investigate the endurance performance in the male basketball players according to age categories.

Methods

Participants

A total of 89 male healthy basketball players between the ages of 10-16 have participated in this study voluntarily (Table 1). The age categories were determined as follows: under-12 (U12, n=35) as 'novice', under-14 (U14, n=34) as 'little', under-16 (U16, n=20) as 'youth', and under-18 (U18, n=10) as 'junior'. Before the study, the athletes and their parents were asked to fill in the informed consent form, and also, "Ethical Board Approval" was obtained from the University Faculty of Medicine.

Table 1. Characteristics of the subjects

	U12	U14	U16	U18
Age (year)	10.7±0.5	12.4±0.5	14.2±0.4	16.0±0.0
Years of experience (year)	4.1±1.3	4.9±1.7	6.7±2.3	9.1±1.5
Body height (cm)	152.5±8.8	163.4±8.9	179.4±6.0	182.3±6.4
Body weight (kg)	44.7±10.1	52.9±9.5	68.6±11.2	73.9±12.5

Study protocol

A 20 meter shuttle-run test was applied to measure the endurance performance of the participants. The 20 meter shuttle run test is a maximum 20-stage shuttle run that is used to measure aerobic endurance in children besides the athletes. The participants were asked to run for 20 meters in a specified area while following the pace of the given signals. The running speed steadily increased after a slow start. From a starting speed of 8.5 km/h, the frequency of the running rhythm rises by 0.5 km/h per minute. The participants were instructed to position in the 2 m-area at the ends of the 20 m-area for every "beep" voice they heard, with the test ending when they missed the signal 2 times. An estimated VO_{2max} was determined based on the number of shuttles obtained (Gürses & Akalan, 2018; Léger, Mercier, Gadoury, & Lambert, 1988).

VO_{2max} (ml.kg/min)= 31.025 + 3.238speed – 3.248age +0.1536speed x age

VO_{2max}, number of laps and total distance parameters are examined in this study.

Data analysis

Normality analyses of the data were tested using visual (histogram, probability plots) and analytical (Shapiro Wilk's test) methods. The descriptive statistics and hypothesis tests were performed by using the Sigma Plot 12.0 (Systat Software Inc.) program. One-way analysis of variance was used to determine the differences between the age categories. Data which passed the equality of variance test were analyzed with Tukey statistics. P values below 0.05 were considered statistically significant ($p<0.05$).

Results

A quantitative increase was observed in the number of laps and total distances in the shuttle-run of the male basketball players with age. With rising age, the participants' VO_{2max} show a minimal quantitative decrease and increase (Table 2).

Table 2. VO_{2max}, number of laps and total distance by age categories

	U12	U14	U16	U18
VO_{2max} (ml.kg/min)	50.1±3.4	47.9±3.8	49.1±2.9	51.7±5.1
No. of laps	45.6±13.2	49.1±14.0	66.0±13.0	86.6±18.8
Total distance (m)	906.9±267.5	988.8±282.4	1286±235.9	1736±375.8

Only the categories of U14 and U12's VO_{2max} were found significantly different. In addition, the increase in the number of laps and total distance was found a significantly different between age categories (there is no significant difference only between U12 and U14) (Table 3).

Table 3. Comparison of endurance performance by age categories

	VO_{2max}			No. of laps			Total distance		
	Diff.	p	p<0.05	Diff.	p	p<0.05	Diff.	p	p<0.05
U18 vs. U12	.07	.959	NS	41	<.001	S	782.1	<.001	S
U18 vs. U14	2.27	.112	NS	37.5	<.001	S	710.9	<.001	S
U18 vs. U16	1.92	.218	NS	20.7	.002	S	439.0	<.001	S
U16 vs. U12	1.99	.066	NS	20.4	<.001	S	343.1	<.001	S
U16 vs. U14	.35	.743	NS	16.8	<.001	S	271.9	<.001	S
U14 vs. U12	2.34	.008	S	3.6	.721	NS	71.2	.301	NS

Discussion

Basketball, as is known, is both an aerobic and anaerobic sports discipline. For this reason, the endurance performances of athletes are crucial. The literature indicates that endurance in various sports branches increases with age.

Chittibabu & Akilan (2013) observed as a consequence of their basketball-specific endurance trainings that the last test measurements of the experimental group were significantly different from the control group. A quantitative increase in the number of laps and the total distances in the shuttle-run of male basketball players with age were also observed in our study. With rising age, the participants' VO_{2max} show a minimal quantitative decrease and increase. In addition, VO_{2max} of male basketball players at different age categories were found significantly different for only the categories of U14 and U12. A significant difference was found in the number of laps and total distance between the age categories (there is no significant difference only between U12 and U14). Apart from growth and development, it can be concluded that the endurance increase with age is attributed to the own characteristics of the basketball branch.

In a study on the relationship between relative age and performance, Arrieta et al. (2016) found that older athletes' performance and length of participation in the game were greater than athletes in the same category who were younger on a month or year basis.

In another study in which the endurance performance of U12, U15 and U18 male basketball players was examined, an evaluation was made over the subjects' the total time obtained in 20 m shuttle run. It was observed that there is a significant increase in endurance durations (5:01±1:40, 6:29±1:44, 8:42±1:44 min:sec, respectively) of the subjects with ages (Nikolaidis et al., 2015).

Elferink-Gemser et al. (2012) measured annually the intermittent endurance capacity of players in the talent development programs of two professional soccer clubs for 10 years from the 2000-01 competition seasons. The athletes are classified into seven age categories. The study was concluded with 953 measurements of 492 players involved. The improvement in intermittent endurance capacities from the season 2000-01 to the season 2009-10 was found to be approximately 50% across all age groups. The increase in endurance capacity with age corresponds to our study's findings. This increase can be explained by the increasing amount and quality of trainings over the years. From this perspective, it is reasonable to conclude that the endurance performances of athletes competing in various sports disciplines but belonging to the same age groups are similar.

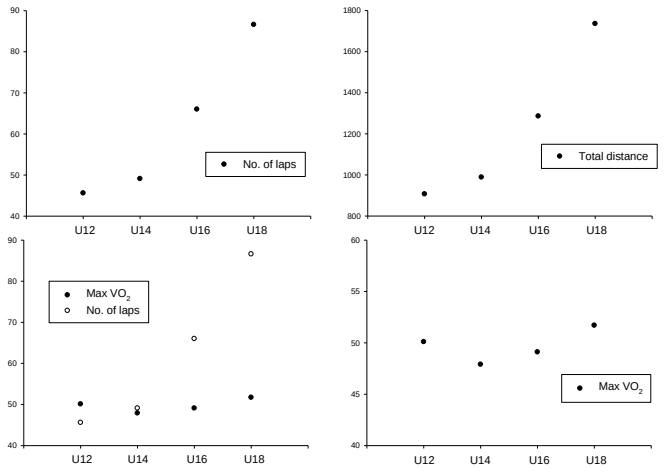
Marinković & Pavlović (2013) determined that the players in the guard position had the highest VO_{2max} in their study, which compared aerobic capacities according to playing positions. Based on this study, VO_{2max} among different age groups can also be compared between positions.

The 20 meter shuttle-run test is the most popular field test used to determine and evaluate cardiovascular endurance in children and young (Olds, Tomkinson, Léger, & Cazorla, 2006; G. Tomkinson, Léger, Olds, & Cazorla, 2003). In this study, the endurance performances (VO_{2max}, the number of laps, total distance) of child and young male basketball players were determined with a 20-meter shuttle-run and these performances show differences according to the age groups.

Tomkinson et al. (2017) examined the 20-meter shuttle-run test results of over one million healthy children aged 9 to 17 in fifty different countries at one norm. In this study, the percentile in which the age-based VO_{2max} in the 9-17 age range is presented. Among the endurance performance investigated in such a large population; our research group performance has been determined in the 70-90% percentile. In another study, it has been determined that with increasing age, physical properties increase and athletic performance (such as jump, speed and agility) rise in basketball players (Cengizel, Öz, & Cengizel, 2020).

Conclusion

As a result, it is determined that the endurance performance of male basketball athletes increases with age. Although U14 endurance performance is quantitatively higher than U12, this difference is not significant. In addition, although it is found that the total distance increases with age, the differences in VO_{2max} are minimal (Figure 1 Endurance performance in basketball by different age categories).



The explanation why endurance performance (number of laps and total distance) improves with age but VO_{2max} remain roughly the same in any age group can be explained by the increase in lung volume and capacities at similar rates as muscle mass and body weight increase due to growth and development. A similar quantitative increase in body weight, muscle mass, and lung volume and capacity

may cause the estimated maximum oxygen consumed per kilogram to be similar. Therefore, it is important to identify children with higher VO_{2max} at a younger age, especially for talent selection. This is because high-intensity training planning will increase the risk of injury and exhaustion in all sports branches. In this regard, trainings aiming to predict the development of performance based on the athlete's age and level are critical.

This study is important in determining the endurance performance of athletes in childhood, adolescence, and youth, as it covers all age categories. The lack of difference between the novice and little teams is suggested to be investigated in terms of puberty and/or reaching puberty.

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