ANALYSIS OF FUNCTIONAL ABILITIES OF PROFESSIONAL BASKETBALL PLAYERS OF DIFFERENT LEVELS OF COMPETITION USING OMNIA SOFTWARE

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Abstract:

The aim of this paper is to use OMNIA software to compare the functional characteristics of senior basketball players at different competitive levels. OMNIA is the software platform developed by COSMED to help sports scientists, clinicians, researchers, and health professionals provide the highest standard of data management. An experimental study was conducted on 87 professional basketball players. They were classified into three categories of players of the competitive level in which they perform. The highest rank of the competition is the Euroleague (n=30). The second rank of the competition is the ABA league (n=30), and the third rank of the competition is the Serbian KLS league (n=27). A conveyor belt (HP-COSMOS®) was used to implement CPET, and VO2max as a measure of aerobic capacity was determined using the Quark CPET system (Cosmed®). A statistically significant difference was found in functional capacity between the highest and third ranks of competition. In today's modern basketball, the success of an individual's playing depends on many factors that act synergistically. Morphological and functional abilities are only one part of the equation that can be the starting point for selection but not the final determinant of successful basketball. There are many other factors to consider.

Keywords:

Software, Sports Data, Functional Capacity, Professional Athletes, Basketball.

INTRODUCTION

Basketball is one of the most popular sports games in the world, gathering millions of players around the world at different levels of competition. The importance of the application of modern technology in the diagnosis of basketball players is gaining more and more importance both in the technology of the game itself and in health parameters [1] [2]. Software monitoring, especially before the beginning of the training process and competition, has become more and more necessary for analysing the functional abilities and metabolic functions of the organism of individuals and assessing their health status and physical preparedness [3]. The importance of application of this software research has a great role in the prevention of injuries and health risks, such as sudden cardiac death in sports.

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To measure the functional abilities of basketball players and other professional athletes, specific load tests on a treadmill (treadmill) are used to simulate intense physical effort, while metabolic and functional parameters are monitored through various software available on the market. This software allows accurate determination of VO2 max values and provides useful information about the current level of physical fitness of the individual. In professional sports, maximal oxygen consumption plays a key role in sports endurance and performance [4]. Oxygen consumption can be measured indirectly on the field through field tests or directly in a cardiopulmonary diagnostic laboratory.

Direct measurement of athletes' functional parameters using available software is extremely important, primarily from a health perspective, and for quality training dosing that can be based on an individual level. Thanks to modern technology and software designed for sports challenges, coaches find it much easier to organise training sessions for professional athletes. Simultaneously, it's easier to determine the level of fatigue in players and assist them in recovery using various apparatuses based on modern technology. Basketball players require a high level of aerobic fitness to cope with the demands of their sports, but the nature and demands of the sports themselves can lead to different levels of VO2 max. When it comes to professional basketball players, VO2 max is often considered a key indicator of their aerobic endurance [5] studies have shown that basketball players often have high VO2 max values, which is due to a combination of factors such as intense intervals of fast running, jumping and fast changes in the direction of movement during matches. These demands require a high level of aerobic endurance to maintain high energy expenditure over extended periods of play [6]. The fact is that professional basketball players, although they do not rely as much on continuous aerobic activity as football players, show high values of VO2 max. Studies have identified average VO2 max values in basketball players in the range of 50-55 ml/kg/min, with the best players having values as high as 58 ml/kg/min [7]. This high aerobic capacity in basketball players allows them to move quickly around the court, recover efficiently between efforts, and endure demanding games [8]. Besides aerobic capacity, anaerobic abilities are of paramount importance in sports because the sports game or competition itself takes place under anaerobic conditions, meaning in conditions that do not require the presence of oxygen to provide energy.

The body's anaerobic capacities are an important aspect of sports, especially in games like basketball. These abilities are crucial for performing short, explosive activities that require speed, strength, and endurance when oxygen is not available in sufficient quantities.

In basketball, anaerobic capacities are crucial for quick transitions from defense to offense, jumping, and rapid changes in direction. Similarly, in football, these abilities are essential for players during fast runs, jumps, and quick passes. Training focused on improving anaerobic abilities involves various methods, including interval training, explosive exercises, and strength training. These training methods can increase the capacity of anaerobic metabolism and accelerate players' reactions in fast and explosive situations on the field.

This research aims to determine, by using the OMNIA software for metabolic and functional testing, whether Serbian professional basketball players have similar functional abilities described in the literature and to determine at the same time whether there are differences in these abilities among basketball players of different levels of competition.

2. MATERIALS AND METHODS

2.1. PARTICIPANTS

The sample of respondents for this research consisted of 87 senior professional man basketball players. They were classified into three categories of players of the competitive level at which they perform. The highest rank of the competition is the Euroleague, the highest quality league in Europe, and the second in the world after the NBA, where 30 basketball players were tested. The second rank of the competition is the ABA league, the highest quality in the region of former Yugoslavia and the Balkans, from which 30 basketball players were tested, while the third rank of the competition is the Serbian KLS league, which gathers the best senior teams in Serbia, which do not play in the ABA league. This study included healthy athletes aged 20 to 35 years, with no history of injuries or absences from training or competition in the last 12 months. The sports medical examination was conducted at the "Vita Maxima" sports medicine clinic in Belgrade by expert professionals, and written informed consent was obtained from all participants. Research procedures adhered to ethical standards defined in the Helsinki Declaration.

Assessment of aerobic capacity involved measuring maximum oxygen consumption (VO2max) on a treadmill, while evaluation of anaerobic abilities utilized the respiratory exchange ratio (RER) obtained at the conclusion after the treadmill test.

2.2. PROCEDURES

The anthropometric characteristics of participants were measured using a Seca stadiometer, with measurements recorded in centimeters. Body weight, body mass index, and percentage of body fat were determined using the Tanita® BC-418MA bioimpedance method. Resting electrocardiograms were conducted using a 12-channel ECG machine (Fukuda). Cardiopulmonary exercise tests (CPET) were performed on a treadmill (HP-COSMOS®), with assessment of aerobic capacity conducted by measuring VO2max through direct monitoring of gas exchange using the OMNIA Quark CPET system (Cosmed®).

The Cardiopulmonary Exercise Test (CPET), serving as a comprehensive assessment tool, was administered to evaluate the overall health and functional capacity of athletes under maximal physical stress. Utilizing a treadmill, the maximal stress test was conducted with participants equipped with essential gear including a face mask, a heart rate monitor (COSMED Wireless HR Monitor, Rome, Italy), and a portable ECG device (Quarck T 12x, Wireless 12-lead ECG, Rome, Italy). Adhering to the protocol designed for professional athletes, the initial treadmill settings were established at a speed of 6 km/h and an incline of 3°. Throughout the test, the treadmill speed increased by 1 km/h every 40 seconds, while the incline remained constant. Oxygen consumption kinetics were continuously monitored using the breath-by-breath analysis technique (Quark CPET system and Omnia software manufactured by Cosmed, Rome, Italy). The pulse rate was simultaneously tracked with a portable ECG device. To ensure maximal effort, the test criteria included achieving 90% or more of the predicted maximum heart rate based on age and gender (220 - age), demonstrating a plateau in oxygen consumption despite escalating workload (plateau < 150 mL O2/min), and achieving a respiratory exchange ratio of 1.10, alongside volitional exhaustion. The entire testing procedure was overseen by trained physicians, and all testing equipment underwent regular calibration for gas volume and calibration before each testing session. Continuous 12-lead Stress ECG monitoring enabled the detection of potential rhythm and conductivity disturbances, as well as variations in the ST-T segment, providing comprehensive insights into the participants' cardiovascular response to maximal exertion.

Oxygen pulse (O2/HR), as an indirect indicator of left ventricular function (oxygen volume ejected from the ventricles with each heart contraction), was measured and evaluated using the Wasserman 9-Panel Plot. In addition to assessing the maximal oxygen pulse value at the end of the test, the kinetics of the O2/HR curve during CPET were continuously monitored to assess left ventricular contractility in terms of meeting the body's metabolic oxygen needs. With increasing heart rate and effort intensity, an exponential increase in the O2/HR curve was expected as a normal response during the test. The plateau of the curve growth occurred in the final phases of CPET, at maximum intensity. The results are processed through the OMNIA software of the company COSMED Italy, which minimizes the test time and the human error factor and provides real-time data during the test itself.

3. RESULTS

The ANOVA test did not show a statistically significant difference in VO2max values between teams of different competitive ranks ($p > 0.05$). The results of the VO2 max tests between Euroleague and KLS league basketball players did not show a statistically significant difference ($p > 0.05$) (Figure 1). Additionally, there was no statistically significant difference in RER values between the two ranks of competition ($p > 0.05$), as shown in Figure 1.

Regarding RER values at the end of the test, as a reflection of the anaerobic power of basketball players, the One-Way ANOVA test showed a statistically significant difference in the values of this variable in favour of lower-ranked teams ($p = 0.053$). Basketball players who competed in the ABA and KLS leagues achieved higher RER values than Euroleague basketball players. They were able to better tolerate anaerobic fatigue for longer periods at a given time of testing. Post hoc Bonferroni test confirmed a statistically significant difference between the achieved RER values at the end of the test between Euroleague and KLS league basketball players ($p <0.05$). At the same time, there was no statistically significant difference between Euroleague and ABA league basketball players nor between ABA and KLS league basketball players, as seen in Figures 2 and 3 ($p > 0.05$).

Table 1. Values of V02 max and RER basketball players of different levels of competition.

Variable	Euroleague	ABA league3	KLS league
Number	30	30	27
V02 max	54.05±5.43	53.80±5.1	54.43±5.16
RER	1.08±0.04	1.09±0.05	1.10±0.03

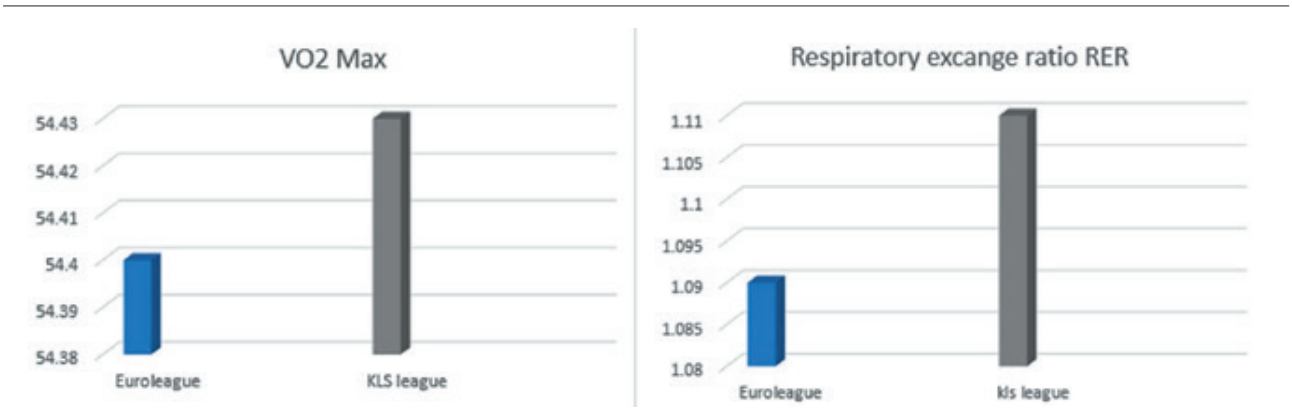

Figure 1. VO2 max and RER values of basketball players from the Euroleague and KLS league.

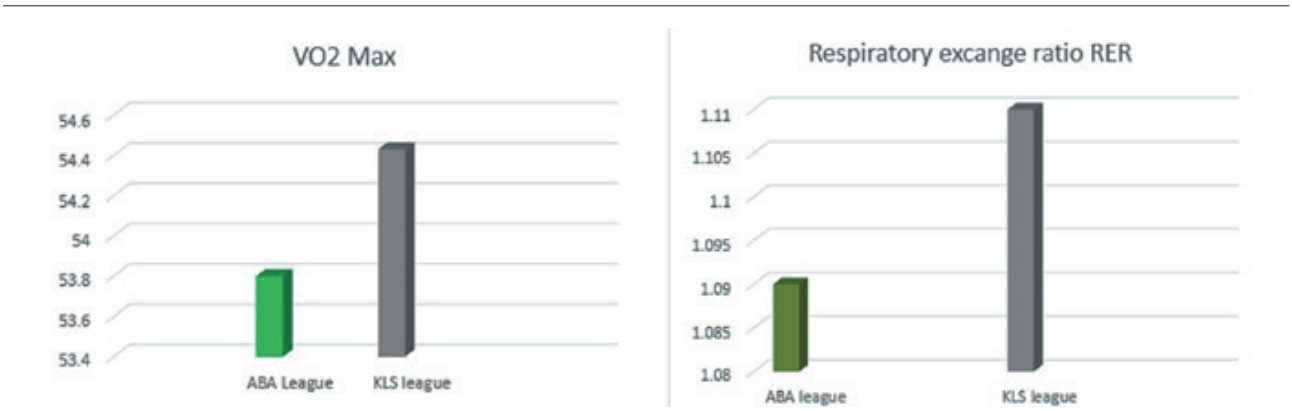

Figure 2. VO2 max and RER values of basketball players from the ABA league and KLS league.

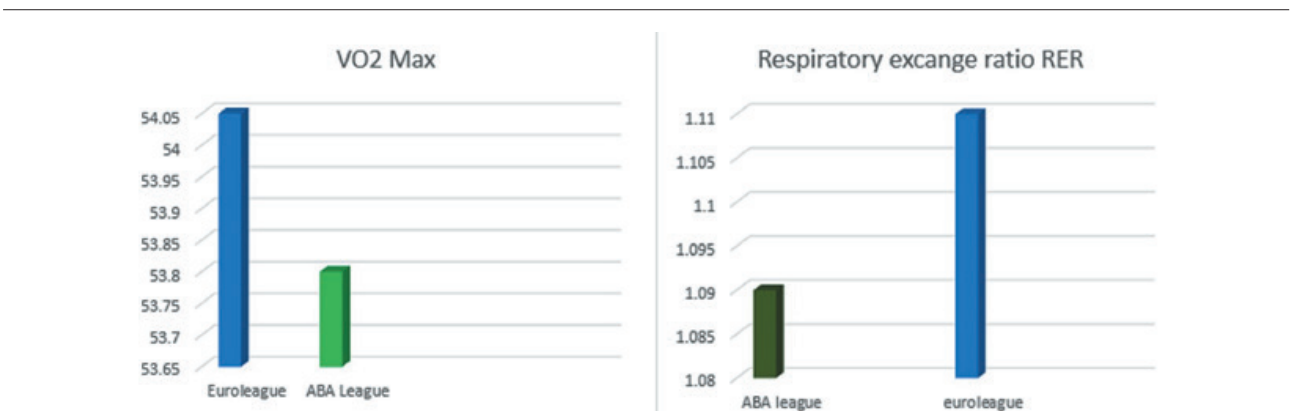

Figure 3. VO2 max and RER values of basketball players from the ABA league and Euroleague.

The results of this research on the functional abilities of athletes using the OMNIA software showed that no statistically significant difference was found between players of different ranks of competition, which even found minimal difference in V02max in favour of lower-ranking players. Another study showed a difference in the aerobic ability of the basketball players of the three different leagues from Turkey [9]. Furthermore, the players from our study had generally much better functional abilities (Vo2max) than the athletes from the study which were measured during the season and in the playoff and from a study that compared V02max in players in a 5x5, 3x3 and 2x2 game. Two earlier studies from the USA conducted at different periods showed similar results [10, 11]. It is estimated that, due to the higher anaerobic component of basketball, players of elite rank should have better anaerobic ability and that players of lower rank can have better V02Max.

At the same time, the team from the elite rank has a larger number of quality individual players and, thus, the opportunity to distribute the minutes adequately between a larger number of players. [12] For lower-level teams, there is less selection, one game during the week, and more training that contains an aerobic component. Due to poor selection, better players from lower-level teams spend more time in the game, which can affect greater aerobic abilities [13]. However, this research did not fully complete the thesis that elite players have greater anaerobic capacity, which does not coincide with the results of the study from Italy [14, 15]. The results showed that the players from the KLS league, the third rank in the competition, have a greater tolerance for anaerobic efforts. In other words, they were able to better tolerate anaerobic fatigue for longer periods at the given time of testing. The test confirmed a statistically significant difference between the achieved RER values at the end of the test between Euroleague and KLS league basketball players ($p < 0.05$), while there were no statistically significant differences between Euroleague and ABA league basketball players nor between ABA and KLS league basketball players ($p > 0.05$). However, this research did not fully complete the thesis that elite players have greater anaerobic capacity, which does not coincide with the results of the study Ferioli [15]. The results showed that the players from the KLS league, the third rank in the competition, have a greater tolerance for anaerobic efforts. In other words, they were able to better tolerate anaerobic fatigue for longer periods at the given time of testing.

The test confirmed a statistically significant difference between the achieved RER values at the end of the test between Euroleague and KLS league basketball players ($p < 0.05$), while there were no statistically significant differences between Euroleague and ABA league basketball players nor between ABA and KLS league basketball players ($p > 0.05$). The limits of this study are in the impossibility of comparing the motor abilities and the situational efficiency of these subjects on the basketball court. Namely, in addition to functional abilities and morphological characteristics in basketball, motor skills (power, speed, explosiveness, precision, coordination, etc.) play a major role in playing successful basketball, so in that segment, a difference can be found in why some respondents play a better level of competition about others even though they have similar or the same functional abilities and morphological characteristics. Further research could go in the direction of the situational efficiency of basketball players and different levels of motor skills. In addition to functional abilities and morphological characteristics, other segments such as cognitive and conative abilities, decision-making, precision, speed, etc., are important for successful basketball playing

4. CONCLUSION

Omnia software is an excellent tool for diagnosing the functional abilities of athletes and ordinary people. Our research has shown that the functional capacity of professional athletes can be tested very successfully, and any difference in their values can be found. Our results show that Aerobic abilities (V02 max) do not differ statistically significantly among senior basketball players at different competitive levels. This data supports the fact that lower-level players have similar or the same aerobic abilities as elite basketball players. Due to the competition in which they play and the fact that they do not have frequent games, lower-ranking basketball players can conduct a larger volume (volume) of work every week, predominantly in the aerobic mode. Anaerobic capacity (RER) is lactate tolerance in response to stress and differs in senior basketball players at different competitive levels. The test showed a statistically significant difference in the values of this variable in favour of lower-ranked teams. Basketball players who competed in the ABA and KLS leagues achieved higher RER values than Euroleague basketball players. From all this, it can be concluded that, in today's modern basketball, the success of an individual's playing depends on synergistic factors.

It has already been stated earlier that, to predict success in playing basketball, the equation of specification is important, i.e., a set of a large number of factors which interact with success.

5. ACKNOWLEDGEMENTS

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