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ANAEROBIC PERFORMANCE IN ELITE YOUTH BASKETBALL PLAYERS: SEASONAL CHANGES AND BETWEEN-TESTS RELATIONSHIP

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SANTRAUKA

ELITO JAUNIMO KREPŠININKŲ ANAEROBINIO PARENGTUMO RODIKLIŲ KAITA SEZONO METU IR JŲ TARPUSAVIO RYŠYS

Darbo aktualumas. Krepšinis yra komandinė sporto šaka, dinamiškas žaidimas, susidedantis iš trumpų ir greitų judėjimo intervalų, kai, keičiantis greičiui ir krypčiai, šuoliai yra neatsiejama žaidimo reikalavimų dalis. Krepšinio rungtynėse svarbu gebėti atlikti didelio ir mažo intensyvumo veiksmus su pertraukomis. Didelio intensyvumo veiksmai tokie kaip šuolis į viršų, pagreitėjimai, krypties keitimas, stabdymai yra būtini siekiant rezultatų rungtynėse. Tačiau reikalavimai skiriasi priklausomai nuo žaidėjų amžiaus, lygio ir lyties. Tam fizinis pasirengimas gali būti vertinamas pagal įvairius komponentus, įskaitant širdies ir kvėpavimo ar raumenų ištvermę (Mancha-Triguero ir kt., 2020).

Tyrimo tikslas. ištirti elitinio jaunimo krepšininkų anaerobinius rezultatus: sezoninius pokyčius ir testų bei kūno dydžio rodiklių ryšį.

Tyrimo uždaviniai:

1. Ištirti elitinio jaunimo krepšininkų fizinio pajėgumo pokyčius sezono metu.
2. Ištirti ir įvertinti ryšį tarp greičio, judrumo ir vertikalaus šuolio atlikimo tarp elitinio jaunimo krepšininkų.
3. Ištirti ir įvertinti ryšius tarp testų ir kūno dydžio rodiklių elitinio jaunimo krepšininkų grupėse.

Tiriamųjų kontingentas. Tyrime dalyvavo 17 krepšininkų, kuriems kas mėnesį buvo atliekami testai. Tiriamųjų amžius - 17,76 ± 1,30, ūgis - 198,52 ± 8,22 cm, o kūno svoris - 86,41 ± 8,58 kg. Visi krepšininkai buvo vyrai, žaidžiantys antroje ir trečioje Lietuvos krepšinio lygose.

Tyrimo metodika. Tyrimai buvo atlikti keturis kartus - T1, T2, T3, T4. Fizinio parengtumo įvertinimas: šuolio į aukštį (CMJ) testas, šuolio su laisvu rankų mostu testas (CMJ FA), 10 m bėgimo sprinte testas, 20 m bėgimo sprinte testas, vikrumo testas.

Išvados. 1. Taikyta treniruočių programa parodo CMJ ($t = 2,73$; $p = 0,015$) testo rezultato ir vikrumo testo ($Z = –2,012$; $p <0,05$) tarp T1 ir T4 padidėjimo rodiklius, bet ne greičio rodiklius ($p> 0,05$).

2. Koreliacija tarp judrumo ir šuolių į aukštį rodiklių buvo vidutinio stiprumo, didėjant judrumui, blogėja šuolio rodikliai (CMJ ir CMJ FA). Koreliacija tarp judrumo ir greičio rodiklių buvo vidutinio stiprumo, nes judrumui didėjant, greičio rezultatas blogėja.

3. Jaunimo elito krepšininkai, kurie yra mažesnio kūno svorio, šoka aukščiau ir bėga greičiau.

Raktiniai žodžiai: *krepšinis, judamieji gebėjimai, anaerobinis parengtumas, testavimas.*

ABSTRACT

Basketball is an invasion team sport, dynamic and intermittent in nature, formed by fast and short displacements, where changes in speed and direction are produced and where jumps are an integral part of the game's demands. These requirements require good physical conditioning, as it is essential to succeed in basketball. However, the demands vary depending on the age, level and gender of the players. For this, physical fitness can be evaluated through different components, including cardiorespiratory or muscular endurance (Mancha-Triguero et al., 2020).

The aim of this study was to investigate anaerobic performance in elite youth basketball players: seasonal changes and the relationships between tests and body sizes indicators.

The **tasks** of the research:

1. To investigate changes across the season in physical performance in youth elite basketball players.
2. To investigate and assess relationships between speed, agility and vertical jump performance in youth elite basketball players.
3. To investigate and assess relationships between tests and body sizes indicators in youth elite basketball players.

Subjects. The study included 17 basketball players who were tested with tests every month. Subjects' age – 17,76±1,30, height – 198,52±8,22 cm, and body weight – 86,41±8,58 kg. All basketball players were men playing in the second and third basketball leagues of Lithuania.

Testings. The tests were initiated four times – T1, T2, T3, T4. Testing of physical fitness: Countermovement jump (CMJ) test, Countermovement jump with free arms (CMJ FA) test, Sprint 10 m running test, Sprint 20 m running test, Lane agility test.

Conclusions:

1. This training programme gives the increase indicators of CMJ ($t = 2.73$; $p = 0.015$) test result and Lane Agility ($Z = -2.012$; $p < 0.05$) between T1 and T4, but not speed indicators ($p > 0.05$).

2. A correlation between agility and vertical jump indicators (was moderate relationships), as the agility increases, the indicators of the jump (CMJ and CMJ FA) deteriorates. A correlation between agility and speed indicators (was moderate relationships), as the agility increases, the speed result deteriorates.

3. The youth elite basketball players who are the lower body weight jump higher and run faster.

Keywords: *basketball, anaerobic performance, mobile abilities, testing.*

TABLE OF CONTENTS

INTRODUCTION

Performance in team sports depends on multiple factors including players' energetic capacity, consisting of anaerobic and aerobic abilities; tactics, technique and the motivation of athletes for maximum use of their potential on the sport field where the quality of these interactions determines the result. These factors combine a complex functional system which is created and modified during physical activities (Sporis, Ruzic, & Leko, 2008b). Many studies have suggested that success in teamsport games appears to include high anaerobic capacity, not aerobic power alone (Sporiš et al, 2014).

Basketball is an invasion team sport, dynamic and intermittent in nature, formed by fast and short displacements, where changes in speed and direction are produced and where jumps are an integral part of the game's demands. These requirements require good physical conditioning, as it is essential to succeed in basketball. However, the demands vary depending on the age, level and gender of the players. For this, physical fitness can be evaluated through different components, including cardiorespiratory or muscular endurance (Mancha-Triguero et al., 2020). Basketball players need to repeat performance of highly intensive work for a particular time combining them with rest intervals. However, the anaerobic power and repetitive work capacity of players has not been extensively analysed all over the world (Paulauskas, 2013).

It has been reported that elite basketball players spend 75% of their playing time with a heart rate greater than 85% of its maximum value. Consequently, to play the sport at the highest level, players must have optimally developed levels of explosive power, agility, aerobic power, anaerobic power and anaerobic capacities (Pojskic et al., 2015). Amani et al (2016) emphasizes that the anaerobic power and anaerobic capacity are the essential factors in success in sport performance.

The most frequent physical demands in basketball include sprints, quick changes of movement direction, different vertical jumps, acceleration (Abdelkrim, Fazaa, Ati, 2007, 2007; Matulaitis et al., 2019). Ongoing testing of basketball players can be expected to be able to optimize the training process and bring success. The scientis said that the weak relationship between agility and sprinting performance in basketball. In particular in 15 years-old basketball players (male and female) (Delextrat, 2015) and professional basketball players (Alemdaroğlu et al., 2012).

The aim of this study was to investigate anaerobic performance in elite youth basketball players: seasonal changes and the relationships between tests and body sizes indicators.

The **tasks** of the research:

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1. LITERATURE REVIEW

1.1. Systems view of anaerobic capacity

Anaerobic endurance is in physiological terms the ability of all living beings' organs and systems, in particular the central nervous system, to function at high intensity, but it is also related to technique and degree of economy in movement. In addition to aerobic endurance, which is the term used when referring to the distance covered (Kemi, et al, 2003).

High-intensity efforts require a high demand of energy, mainly supplied by the non-oxidative metabolic processes. Thus, anaerobic capacity, which is regarded as the maximal amount of energy (i.e., ATP) that can be resynthesized through the phosphagen and glycolytic metabolic pathways, has been considered an important physiological performance determinant in these efforts. Anaerobic capacity evaluation is complex (Miyagi e al, 2017).

By Gater (2009), anaerobic capacity is most commonly reported in terms of peak power output, whereas aerobic capacity is usually expressed in terms of peak oxygen consumption. Krops et al. (2017) emphasizes that anaerobic capacity is the short-term ability to generate energy by metabolizing creatine phosphate and by glycolysis, without using oxygen, whereby lactate accumulates.

Aerobic capacity is the capacity of large skeletal muscle groups to adapt to work by using energy obtained as a result of aerobic metabolism. VO2max is a good indicator of aerobic capacity and is considered to be an indicator of the physiological integration of pulmonary, cardiovascular and neuromuscular functions. Anaerobic capacity is the ability of the muscles to adapt to workouts in the form of very short duration, maximal and supramaximal physical activities (Sozen, Akyildiz, 2018).

Across the life-span, the human body experiences important changes in its physiology. Unfortunately, and in contrast to research on aerobic metabolism, the effect of age on anaerobic metabolism has received very little attention. Indeed, no study has directly measured the changes in anaerobic capacity with age across the life-span. There are, however, a number of cross-sectional studies that compare AnC in different age groups. Anaerobic capacity is lower in children and adolescents compared to adults. Indeed, anaerobic capacity appears to peak around the third decade of life and, thereafter, steadily decreases until death (Reaburn & Dascombe, 2008).

Anaerobic capacity is the ability of the muscles to adapt to workouts in the form of very short duration, maximal and supramaximal physical activities. The contribution towards technique and tactics by the optimal levels of athletic performance components is indispensable but one should not overlook that technical and tactical mentality and conditional components are complementing (Sozen, Akyildiz, 2018).

Joffe (2018) showed that literally anaerobic capacity means an ability to produce energy without oxygen. It possible in three ways: through the limited muscle's ATP stores, creatine phosphate (PCr) utilisation and anaerobic glycolysis. There is small amount of oxygen in muscles in form of myoglobin, which can be used for energy production without external oxygen, but this way is not purely anaerobic. From those three anaerobic pathways, muscles ATP reserve can support just a few seconds of maximal effort, whereas PCr a few dozens of seconds. Both of these two compounds can be restored relatively quick with the presence of oxygen. The third anaerobic pathway uses the same energy compound as aerobic one – glycogen. Although the glycogen stores are comparatively large, however, when they are used anaerobically, they can be spent relatively quickly (in tens of minutes) because this way is around 9 times less efficient than aerobic. In reality, humans don't use particular anaerobic pathways or aerobic ways exclusively. Usually all of them are used simultaneously and in different proportions depending on many different factors. Most important of those factors are: training adaptation, exercise intensity and duration. However, very often, sports practitioners tend to imply different meaning for anaerobic capacity. They use this term to define external work which is produced anaerobically. For example, it can be distances run or cycled. This work is not exactly the same as energy because not all energy can be transferred into external work. And finally, frequently coaches by anaerobic capacity mean ability to produce high intensity work above so called "anaerobic threshold", because they assume that oxygen supply is inadequate there thus work has to be generated anaerobically.

Anaerobic capacity (AnC) can be estimated by subtracting VO(2) consumed from VO(2) demand, which can be estimated from multiple submaximal exercise bouts or by gross efficiency (GE), requiring one submaximal bout (Nordhof et al, 2011).

In summary, anaerobic capacity is the ability of the muscles to adapt to workouts in the form of very short duration, maximal and supramaximal physical activities. Frequently coaches by anaerobic capacity mean ability to produce high intensity work.

1.2. Determinants of anaerobic capacity

However, since measuring anaerobic energy production is difficult a comprehensive review of factors affecting anaerobic capacity is lacking. Therefore, the following section reviews the effects of the number of variables (mode of exercise, gender, age, body composition, and genetics) on anaerobic capacity. In addition, the potential effect of environmental factors (Muniz-Pumares, 2016).

Anaerobic capacity has been determined using different modes of exercise, with the majority of the research conducted using either cycling or running. It is generally accepted that exercise that engages a large muscle mass results in a greater anaerobic energy production. For example, running activates more muscle mass than cycling, and indeed anaerobic capacity determined during running is greater than that determined during cycling (Hill & Vingren, 2011). Furthermore, compared to running on the flat, uphill running results in an increased muscle mass activation and, also, increased anaerobic capacity.

Anaerobic capacity may be influenced by a number of factors, which have since been supported by further research. These include gender, total muscle mass, fiber type and cross-sectional area, phyical training, substrate availability, accumulation of reaction products, the oxygen uptake system, and heredity (Reaburn & Dascombe, 2008).

Men consistently exhibit a greater anaerobic capacity than women, though the magnitude changes from about 20 to 100%, depending on the method used to determine anaerobic capacity. The chief mechanism to explain the higher anaerobic capacity in men is largely attributed to a greater muscle mass. Reported that men completed 22% more work than women in a 30 s all-out test, even when work was expressed relative to lean-mass. Observed that the gender differences in anaerobic capacity, estimated as the accumulated oxygen deficit (AOD), did not disappear when AOD was expressed relative to active muscle mass. Further physiological differences other than higher muscle mass, therefore, need to be considered in order to explain sex differences in anaerobic capacity. In summary, men consistently have a larger anaerobic capacity compared to women, though the precise mechanism(s) to explain those differences remain to be elucidated (Muniz-Pumares, 2016).

Poli et al (2019) showed that the anaerobic capacity findings corroborate with other reports in the literature, in which men presented greater anaerobic capacity than women. However, the anaerobic capacity differences between genders in the literature vary between about 23% and about 30% (i.e., expressed in relative values). These discrepancies can be attributed to differences inherent to the method for estimating anaerobic capacity.

Many have attempted to explain the impairment of muscle anaerobic capacity based on factors such as the cardiovascular strain involved in prolonged anaerobic bouts greater than 30 seconds, muscular damage and an increase in lactate concentration. Meanwhile, the increase in performance has been attributed to a lighter body weight to be resisted following hypohydration (Naharudin, Yusof, 2013).

Anaerobic endurance training is beneficial for athletes whose sports set a high intensity and whose bodies need to utilize anaerobic metabolic processes. High intensity interval training improves both aerobic and anaerobic capacity, e.g., mitochondrial content of the muscle. Anaerobic training usually involves short, intense efforts. It depletes only creatine phospate, thus regeneration is quick following exercises, and this makes it very popular among professional athletes (Radak, 2018).

Sporis et al. (2008a) showed that prolonged motor performance at relatively high speeds leads to fatigue, a consequential decrease in technique and an unsatisfactory final outcome. For this reason, anaerobic endurance training, which helps to delay the onset of fatigue as well as reduces the fatigue effect, can be beneficial.

Exercise performance is one of the most complex human traits due to the number of body systems (musculoskeletal, cardiovascular, respiratory, nervous, etc.) that must interact. Other important components are exercise training and nutrition that influences these traits. There is a growing evidence of gender differences in physiology and metabolism which comes to expression when the male and female body is exposed to increased energy demands during exercise. Women have a lower cardiac output and oxygen binding capacity than men which influences the physical performance in women. There are several distinct gender dimorphisms in skeletal muscle, both in regard to morphology and the molecular machinery. In particular, it is a well-documented finding that women utilize lipids as energy fuel to a larger extent than men during submaximal exercise at the same relative intensity (Lundsgaard, Fritzen, Kiens, 2017).

Durkalec-Michalski et al (2019) founded that body composition is closely related to the level of aerobic and anaerobic capacity in rowers, and we suggest that its regulation can serve as an effective tool to improve physical performance.

Sozen and Akyildiz (2018) found that anaerobic training caused a high level of difference in terms of aerobic capacity values, and thus increased aerobic capacity. It was observed that aerobic training had a positive effect on anaerobic capacity, anaerobic power and the fatigue index. Although aerobic training results in an increase in aerobic capacity of approximately 4%, this increase was not significant.

Physical fitness can be assessed through 5 major components: cardiorespiratory endurance, muscular power/strength, muscular endurance, flexibility, and body composition. An anaerobic activity is defined as energy expenditure that uses anaerobic metabolism (without the use of oxygen) that lasts less than 90 seconds, utilizing an exhaustive effort. Two major energy sources are required during the WAnT. The first is the adenosine triphosphate-phosphocreatine (ATP-PCr) system, which lasts for 3 to 15 seconds during maximum effort.

The second system is anaerobic glycolysis, which can be sustained for the remainder of the all-out effort. Therefore, the WAnT measures the muscles' ability to work using both the ATP-PCr and glycolytic systems. Comparing an athlete's data to a set standard is important for athletes and coaches of sports that require both muscular power and anaerobic capacity (Zupan et al, 2009).

Taskin (2016) argues that in individuals with a high level of anaerobic capacity, recovery after exercise becomes quicker and muscle tiredness does not occur at once. Relevant energy which is consumed during maximal exercises is provided from fats, and therefore, if athletes have high anaerobic capacity, their capacity for sweating off is higher. More important athletes' anaerobic capacity levels are in sportive activities, more important their aerobic capacity levels are in shown performance level. Because, aerobic capacity is an effective physiological criteria for athletes' performance capacity. When individuals' aerobic capacity develops, their heart rates and body composition values develop as well. As an indicator of functional capacities of circulation, respiration and metabolic systems, maximal aerobic power depends on functions of cardiovascular and pulmonary systems, blood diffusion capacity and mitochondria enzyme activities. When capacities of these systems are physiologically high, maximal aerobic capacity will rise.

Anaerobic workout indicates the use of an explosive power and a load that exceeds anaerobic threshold, and is a physical activity type that presents itself with fatigue. Anaerobic activity cannot be sustained for long periods of time. Because, skeletal muscles are operating way above the steady-rate oxygen metabolism and through anaerobic metabolism. This circumstance increases lactate levels in muscle and blood. The buffering of accumulated lactate increases the CO_2 release from the lungs. Fatigue presents itself in muscles due to decrease of pH (pH=6.4) (Sozen, Akyildiz, 2018).

Nasuka et al (2018) founded that no different of the anaerobic capacity and blood lactate level between former elite athlete and non elite athletes. It means, that the anaerobic capacity of the former elite athletes decreased but not lower than non elite athletes. The former elite athletes have been not in peak performance. The age and less exercise may influence the decreasing of anaerobic capacity of former elite athlete. They are also slower because of the increasing of body mass index. The age, mass body index and less exercise may influence the decreasing of anaerobic capacity of former elite athlete.

In summary, anaerobic capacity could depends on mode of exercise, gender, age, body composition, genetics. These factors need to be considered for best results.

1.3. Basketball players anaerobic capacity research

In basketball games, a successful performance mainly dependent on several fitness adaptability part (for example, speed, agility and vertical leap). The movement is in essence anaerobic properties, and these components must be repeated, with the lowest reduce competition for the performance. Basketball players can get better endurance and explosive through anaerobic capacity training which is the basis of the cultivation of outstanding basketball players (Hua, Jing, 2013).

Under such conditions, both the aerobic and anaerobic efficiencies are required for maximum output. Therefore, the aerobic and anaerobic capacities contribute the critical values as the dominant performance factor at basketball game (Singh, V, Bhagat, Singh, T, 2016).

Basketball is an aerobic-based anaerobic sport (Delextrat and Cohen, 2009; Meckell, Casorla, Eliakim, 2009) which requires high intensity activities such as jumping (for rebounds, blocks and shots), turns, dribbles, sprints, screens and low intensity activities such as walking, stopping and jogging. Frequent stoppages in games allow players to recover between bouts of activity, thus allowing repeated high-intensity spells of play (Drinkwater, Pyne, McKenna, 2008). Aerobic capacity is positively associated with recovery during repeated high-intensity bouts (Castagna et al., 2008).

Moreover, the high intensity movements of basketball players are closely related to the development of strength, speed and agility (Meckell, Casorla, Eliakim, 2009). During a basketball game, professional players cover about 3500-5000 m. Each player performs about 1000, mainly short, activities lasting around 2 seconds; time motion analysis has shown that these short activities are performed with a different frequency according to the player's position (Abdelkrim, Fazaa, Ati, 2007). Explosive strength, take-off power, speed, and agility are abilities that make an important contribution to efficient movement with and without the ball, thus play an important role in basketball technique and tactics. The level of these abilities, that is, the motor potential, is most often measured using various motor tests with and without the ball. In basketball practice, motor tests are the most suitable and applicable because they are implemented in similar conditions to those of training or competition (Erculj, Blas, Bracic, 2010).

Basketball is characterized as predominantly anaerobic, with elite athletes often subjected to more than 2,700 actions of intermittent characteristics, which involve walking, running, sprinting, and jumping. From the point of view of high-intensity actions, time–motion studies have reported that 28.49–49.06 % of the actions are sprint, which is considered as one of the most required actions to the athletes. By observing repetition of intermittent efforts in basketball, power endurance appears to be an imperative component of athletic fitness, as the ability to sustain the greatest power during various efforts can be crucial at decisive moments in the game (Gantois et al., 2017).

The aerobic and anaerobic mechanisms are heavily activated to provide energy during basketball practice. Accordingly, the ability to sustain high-intensity intermittent efforts and to produce strength and power are important physical determinants during basketball competitions (Abdelkrim, Fazaa, Ati, 2007).

Anaerobic performance assessed via a repeat-sprint ability test or line drill has been shown to be a predictor of playing time in elite basketball athletes and is considered a crucial element across numerous team sports. Therefore, the greater anaerobic capacity a player has to execute these movements, rapidly change direction and move up and down the court, provides them with an offensive and defensive advantage to successfully evade or pursue opponents. While aerobic endurance in basketball has been shown to be important to maintain a high level of activity for the duration of an entire game it appears the level of aerobic capacity is dependent upon positional requirements. While time-motion analysis reveals the importance anaerobic capacity for basketball performance, a high base of aerobic capacity is required to sustain these movements across the duration of a game. However, positional differences may explain the low correlation observed between aerobic performance and playing time in the current population (Dawes, Marshall, Spiteri, 2016).

The assessment of players' physical fitness across an entire basketball season indicates the effectiveness of conditioning programs and permits quantification of changes in fitness status of players across various phases of the season. The greatest improvement in an athlete' physical fitness usually occurs during the preparation period, when players begin performing physical activity after a prolonged period of complete, or nearly complete rest. During the competitive phase of the season strength and conditioning programs aim to maintain players' physical fitness, although realistically, fitness may slightly increase or decrease. In addition, different individual responses to basketball practice might be expected among players belonging to the same team for several reasons such as playing time, injuries and fatigue status. As such, strength and conditioning coaches should take into consideration the fitness status of their players in developing individualized training sessions or tapering strategies (Ferioli et al, 2020).

Mancha-Triguero et al. (2020) showed that the importance of this capacity in basketball is due to the fact, that the best-classified in the competition teams are capable to perform a greater number of explosive actions. These high intensity actions are characterized by being of greater intensity and for longer than the worst classified teams. Aaerobic and anaerobic physical demands in male basketball players increase with age and there is improvement in technical-tactical performance. The obtained results progressively increase with age in the three categories, showing the influence of maturational development and sports experience. Aerobic and anaerobic physical demands in female basketball players progressively increase with age and stabilize from the age of 16 reaching a plateau, their growth being more gradual.

Depending on the position (guard, forward or center), players develop different physical fitness levels as well as different body compositions and morphological profiles that determine their role on the court. Guards are usually the shortest and fastest players on the team with the best ball handling ability, while centers are the tallest and slowest players on the team. Recent studies have shown that centers are taller and heavier with a higher body fat content than guards and forwards. At the same time, guards have better aerobic and anaerobic capacities, as well as speed and agility, while forwards and centers are better in muscular strength and absolute power (Pojskic et al., 2015).

Strength and conditioning coaches, athletic trainers, and other professionals have constantly studied ways to increase human performance. These individuals have traditionally focused on the development of acceleration and speed, primarily in the sagittal plane. However, this philosophy has recently shifted towards the development of sport specific training. Most sports do not rely solely on forward sprinting; these sports require quick changes in direction and bursts of speed in reaction to each unique situation. An individual's success in sports, specifically basketball, relies on the ability to make quick changes in direction followed by acceleration during competition (Brown, 2012).

In Araujo et al (2014) study, the elite basketball players presented a high anaerobic index but a similar aerobic capacity in relation to other elite sports. Leicht (2008) reported that elite basketball players showed a significant physiological exertion during the game and as a consequence, considerable utilization of anaerobic metabolism. Narazaki et al. (2009) and Montgomery et al. (2010) demonstrated high predominance of aerobic metabolism in teams without elite players. This fact may occur due to the reduced number of high technical level athletes, which limits frequent substitutions during the match. In this context, it is possible to speculate that training for elite teams is directed to develop anaerobic power resulting in a high technical level of the team enabling constant substitutions.

Araujo et al (2014) study data showed that anaerobic performance determined in elite athletes by the RAST was greater when compared with other studies with intermediate teams or physically active subjects (Balčiūnas et al., 2006; Zagatto, Beck, Gobatto, 2009). On the other hand, players from elite teams show an average value of aerobic capacity, which seems to be sufficient to sustain anaerobic metabolism during a single game and throughout the season. In addition, the players with a higher anaerobic index were those with the highest values of aerobic capacity.

The analysis of the internal and external load by means of a test of aerobic and lactic anaerobic capacities is not a common practice in players at training stages. Currently, it is normally used the information that comes from high-level teams or national teams, evaluated through laboratory or generic tests regardless of the sport practiced. For this reason, it is believed that the analysis of physical fitness in young athletes is relevant since occasionally the values obtained by the high-level teams are adapted and the principle of specificity and individualization of the athlete is omitted. Thus, the monitoring of physical fitness in each training period and gender provides the coach with relevant information when planning a competition, existing then a positive relationship between a better physical fitness and a better performance of the athlete in the competition (Mancha-Triguero et al., 2020).

In summary, aerobic and anaerobic mechanisms are heavily activated to provide energy during basketball practice. Basketball players can get better endurance and explosive through anaerobic capacity training which is the basis of the cultivation of outstanding basketball players.

1.4. Relationship between athletes' mobility abilities

Studies investigate relationships between sprinting and muscle strength performance have had different limitations and reported only weak and no relationships so far. The examination of only one joint action or type of muscle contraction, or an incomplete investigation of the relationship between strength and sprint performance measures may be reason of this weak correlations (Alemdaroğlu et al., 2012).

Dhapola and Verba (2017) concluded that there were significant relationship of male university players found between Weight and Agility ($r=.670$, $p<0.05$), weight and speed ($r=.543$, $p<0.05$), BMI and Agility ($r=.546$, $p<0.05$) and BMI and Speed ($r=.752$, $p<0.05$). There was no significant correlation found between height and agility ($r=.164$, $p>0.05$) and height and speed ($r=.065$, $p>0.05$).

Hua and Jing (2013) analyzed the anaerobic capacity of vertical jump and straight-line sprint in basketball athletes training process. They found that anaerobic capacity of straight line's sprint is stronger than anaerobic training process which provides a theoretical reference for the basketball player. The fatigue index between WAnT and linear sprint doesn't have any relationship, this may be due to the fact, that the two test movements are caused by different rules.

Many authors reported a relationship between various measures of sprint and jump performance. Regarding jump performance, Barr and Nolte found a significant correlation between jump performance and 10 m sprint ($r = 0.66$). Bissas and Havenetidis also found a relationship between jump performance and maximal running velocity ($r = 0.73$). Kale et al found a significant correlation between jump height and maximum velocity as well. Squat jump power output has been correlated to 5 m sprint time and 10 m running velocity. Countermovement jump height has also been reported to correlate to acceleration from 0 to 10 m and 25 to 35 m sprint time. The standing long jump has also been shown to significantly correlate to 10, 20, 30, and 40 m average velocity and acceleration values. Very few studies, if any, have examined these various measures of jumping and sprinting ability and agility performance in basketball players. Shalfawi et al. reported a significant correlation between CMJ and 10 m ($r = 0.41$), 20 m ($r = 0.46$) and 40 m ($r = 0.74$) sprint times in professional men (27 years old) basketball players. Chaouachi et al. found a significant negative correlation between agility T test and 5-jump test performance ($r = - 0.61$), but there were no significant correlations between agility T test and 5, 10, and 30 m sprint times in elite male (23 years old) basketball players (Asadi, 2016).

The results of Wisloff et al (2004) confirm that a strong correlation exists between maximal strength, sprinting, and jumping performance in elite soccer players, which supports the findings from earlier work. There were also strong correlations between maximal strength and the 30 m sprint test, including the recorded times between 10 and 30 m where the acceleration is substantially smaller than between 0 and 10 m, and the 10 m shuttle run test, where breaking velocity is part of the performance. Vertical jump height was in line with previous reports on elite soccer players and the relatively strong correlation between vertical jumping performance and sprint times was expected as both are derivatives of maximal strength.

Asadi (2016) study indicated significant relationship between CMJ and 20 m ($r = -0.61$) sprint performance in basketball players. Barr and Nolte (2011) found a significant correlation between jump performance and 10 m ($r = 0.66$).

Another study examined the relationship between speed, agility and vertical jump ability in young soccer players where the average age was 16.0 ± 0.8 years. The speed ability was assessed by 10 and 30 meters sprint test and the vertical jump ability CMJ test. They found low correlations between the height and CMJ and the 10 meters sprint (0.030 and -

0.123) and moderate correlations between CMJ height and the 30 meters sprint (- 0.367 and -0.599) (Koklu et al, 2015).

Wong et al. (2009) in their study showed that body mass was significantly correlated with 30 m sprint time (r=-0.54; p=0.001) while body height was significantly correlated with vertical jump height (r=0.36; p=0.01), 10 m (r=-0.32; p=0.01) and 30m (r=-0.64; p=0.001) sprint times and BMI was significantly correlated with 30 m sprint time (r=-0.24; p=0.05). Hyla et al (2017) results of study with soccer players show no significance association between weight and BMI with sprint performance and significance correlation between height (negative correlation) and percent body fat (positive correlation) with sprint.

Body height is very important for basketball players, particularly for centers and might be one of the reasons for not finding an association between strength and single sprint performance. Another important factor may be the different distances were used in sprint tests in previous studies (Alemdaroğlu et al., 2012).

In summary, many authors reported a relationship between athletes ’mobility abilities but the results are different. This may be due to the choice of different tests, the timing of the test, the physical characteristics of the individual athletes or other factors.

2. RESEARCH METHODOLOGY AND ORGANIZATION

2.1. Subects, Testing equipment and Tests

Subjects. The study included 17 basketball players who were tested with tests every month. Subjects' age, height and body weight were recorded (Table 1). All basketball players were men, playing in the second and third basketball leagues of Lithuania.

Table 1. Subjects' age, heigth, and body weight

Number of subjects	Age (year)	Height (cm)	Body weight (kg)
17	17,76±1,30	198,52±8,22	86,41±8,58

Testing equipment. Optojump next system was used an optical measurement to test the vertical jumps and microgate witty system was used for time recording for the sprint running and lane agility tests (Table 2).

Table 2. Testing equipment

Optojump next system	Microgate witty system
	

Testings. The tests were initiated four times – T1, T2, T3, T4. Testing of physical fitness: Countermovement jump (CMJ) test, Countermovement jump with free arms (CMJ FA) test, Sprint 10 m running test, Sprint 20 m running test, Lane agility test (Figure 1).

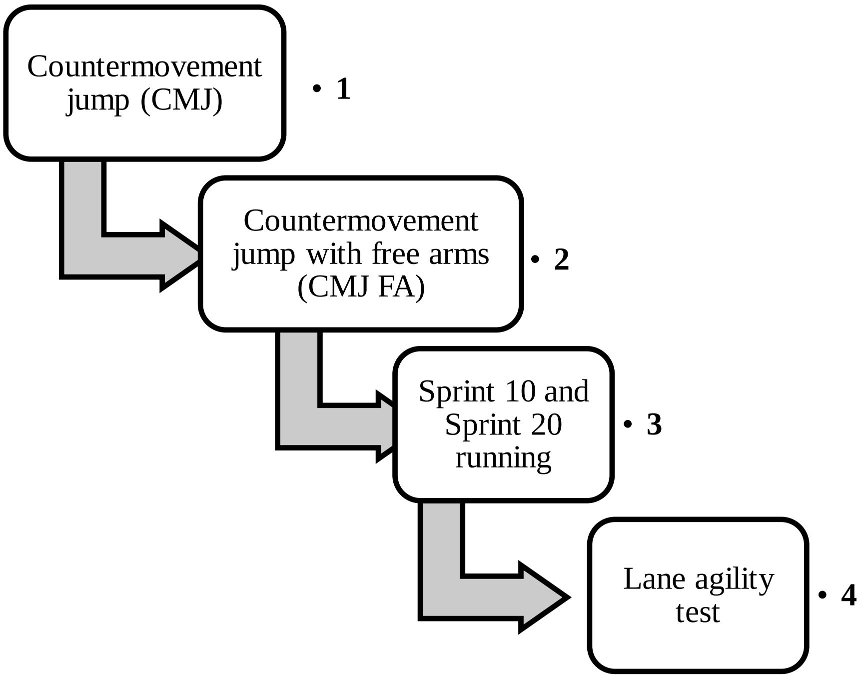

Figure 1. Testing process

The countermovement jump (Figure 2) (CMJ) is a simple, practical, valid, and very reliable measure of lower-body power. As a consequence, it is no surprise that this has become a cornerstone test for many strength and conditioning coaches and sports scientists. The CMJ has been shown to be the most reliable measure of lower-body power compared to other jump tests. Furthermore, the CMJ has been shown to have relationships with sprint performances, 1RM maximal strength, and explosive-strength tests. This suggests that performances in the CMJ are linked with maximal speed, maximal strength, and explosive strength. Contact mats, force platforms, accelerometers, high-speed cameras, and infrared platforms have all been shown to provide a valid and reliable measure of CMJ performance – though force platforms are considered as the 'gold-standard' (Walker, 2016).

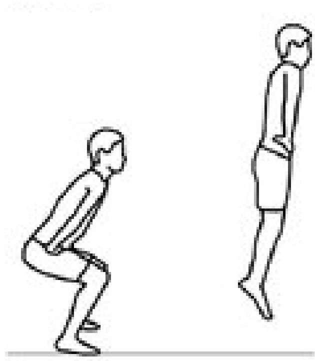

Figure 2. Countermovement jump test (CMJ) (Varalda A, Varalda, M, 2017)

Countermovement jump with free arms (CMJ FA). When jumps with arm swing (Figure 3) are compared with jumps without arm swing, there is empirical evidence that the average height of the jumps is greater than 10% when the arms are used and that the vertical speed of the mass center is greater when there is arm swing. The explanation for the mechanism of the greater height of jump by means of the arms swinging or the arms' momentum has not been described sufficiently (Acero et al, 2012).

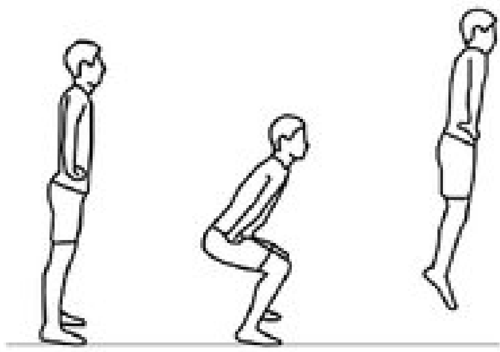

Figure 3. Countermovement jump with free arms (CMJ FA) (Acero et al., 2012)

The **10 m and 20 m sprint test** is a simple and popular test used to measure an athlete's ability to accelerate (Figure 4). As short-distance accelerations are common in a large variety of sports, this test is often included in performance testing batteries. Both handheld stopwatches and electronic timing gates have been proven to be reliable assessment devices.

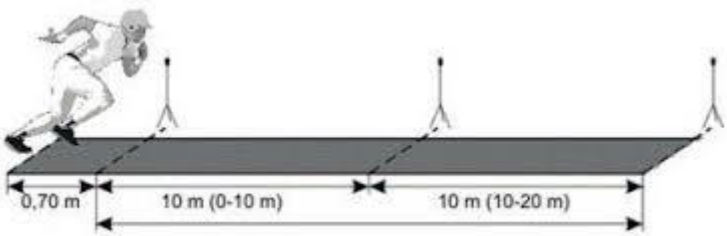

Figure 4. Sprint 10 and sprint 20 m running test (Pliauga et al, 2018)

Change of direction speed was evaluated using the ***lane agility test***. Cones were positioned at all 4 corners of the key-way on a standard sized basketball court (Figure 5). From a standing start at the left hand corner of the free throw line facing the baseline (cone A), players were instructed to sprint forward to the 1st cone at the baseline (cone B), shuffle right to the 2nd cone at the baseline (cone C), run backward to the 3rd cone at the free throw line (cone D), shuffle left to the 4th cone at the free throw line (cone A), change directions to shuffle to the right back to the 3rd cone (cone D), sprint forward to the 2nd cone (cone C), shuffle left to the 1st cone (cone B), and finish by backpedaling to the 4th cone at the original start position (cone A) (Dawes, Marshall, Spiteri, 2016).

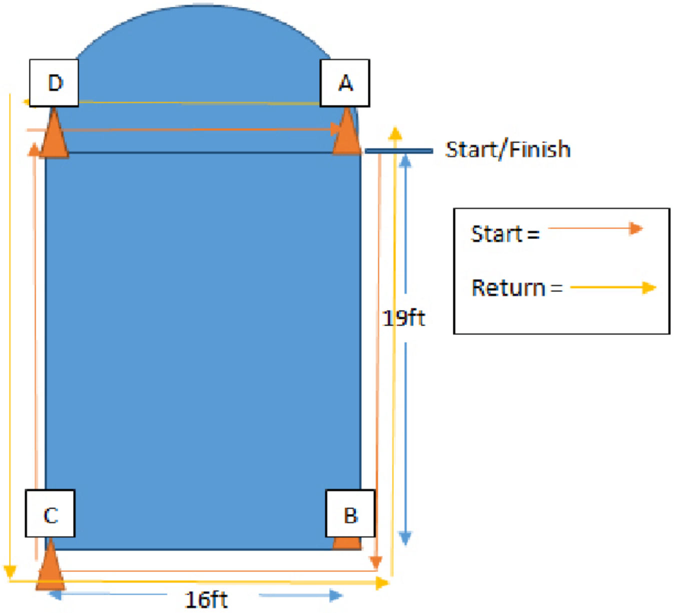

Figure 5. Basketball lane agility test (Dawes, Marshall, Spiteri, 2016)

2.2. Organization of research

All testing was performed indoors on basketball court. CMJ test performance: after warming-up the basketball players took 3 maximum jumps in a row. There was rest time up to 20 s between jumps. After the jumps, the basketball players were told to move actively, waiting for the next test. The highest jump was selected for the study.

The same performance for CMJ FA test: the basketball players took 3 maximum jumps in a row. There was rest time up to 20 s between jumps. After the jumps, the basketball players were told to move actively, waiting for the next test. The highest jump was selected for the study.

Sprint 10 and sprint 20 tests. Three gates were used in this test (at the starting position, at 10 m and at 20 m), so the results of both 10 meters and 20 meters were recorded in one run. The basketball players were instructed to run as fast as possible from a standing start position with maximum effort each time. Running 3 times of each sprint tests. The best 10 and 20 m running result is taken into account.

Basketball lane agility test was performed the last. Performance: start, sprint (1), right shuffle (2), back pedal (3), left shuffle (4), right shuffle (5), sprint (6), left shuffle (7), back pedal (8), finish. basketball players performed the test 2 times, one after the other. Thus, 2 trials were performed, with 3-4 minutes of active rest. The best result was selected for the study.

No additional effects were observed in the study. The normal training routine was followed. Testing was performed every four weeks. The testing schedule is given in the figure 6.

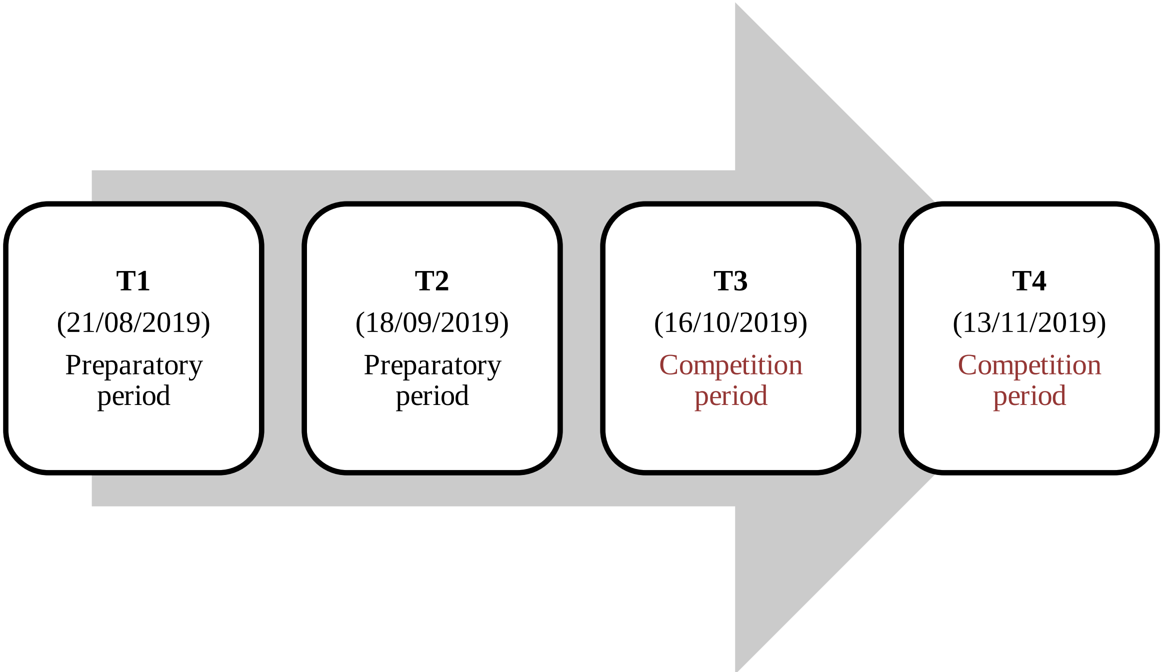

Figure 6. The testing schedule

Statistical data analysis was performed using SPSS V.19 and Office Excel 2016 program. The calculations included the determination of the arithmetic average, standard deviation, the reliability of the differences between averages in accordance with the Student criterion for independent samples (that the normality of the distribution was tested by applying Kolmogorov-Smirnov criterion). In the assessment of the reliability of the results, the difference was deemed to be statistically significance where $p < 0.05$ (the reliability of 95%). In order to evaluate the reproducibility of the test results the intraclass correlation coefficient was calculated.

3. RESULTS

3.1. The Changes Across The Season In Physical Performance

Found that from the first test (T1) to the fourth test (T4) the results of basketball players improved from 40,54±5,16 to 42,45±4,64 (Figure 7). T1, T2, T3, T4 does not contradict the law of normalcy Shapiro-Wilk test p> 0.05, parametric criteria can be used. Significant increase in result CMJ 1.91 cm (t = 2.73; p = 0.015) between T1 and T4 test result.

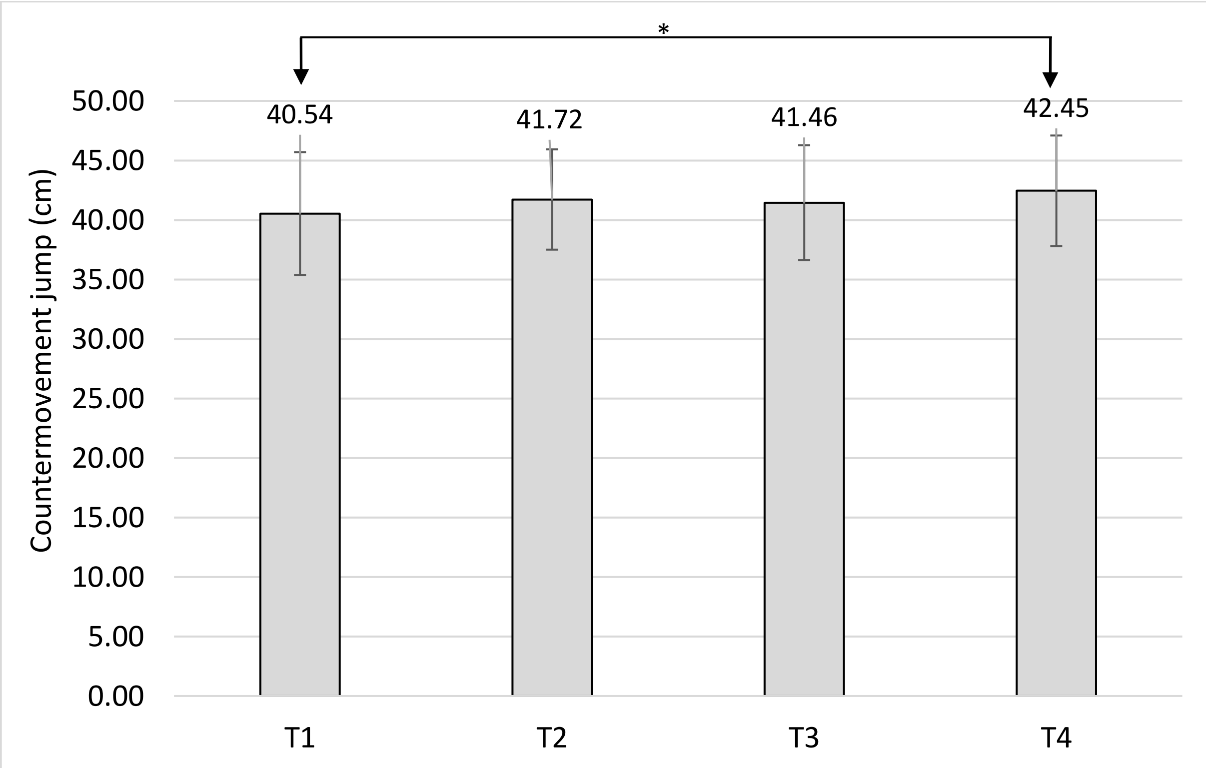

Figure 7. Countermovement jump (CMJ) test results (cm)

The results of the countermovement jump with free arms swings tests were similar throughout the tests from 50,68±6,19 cm (T1) to 50,42±5,57 cm (T4). There is no significant increase in result in countermovement jump with free arms swings between T1 and T4 (Figure 8).

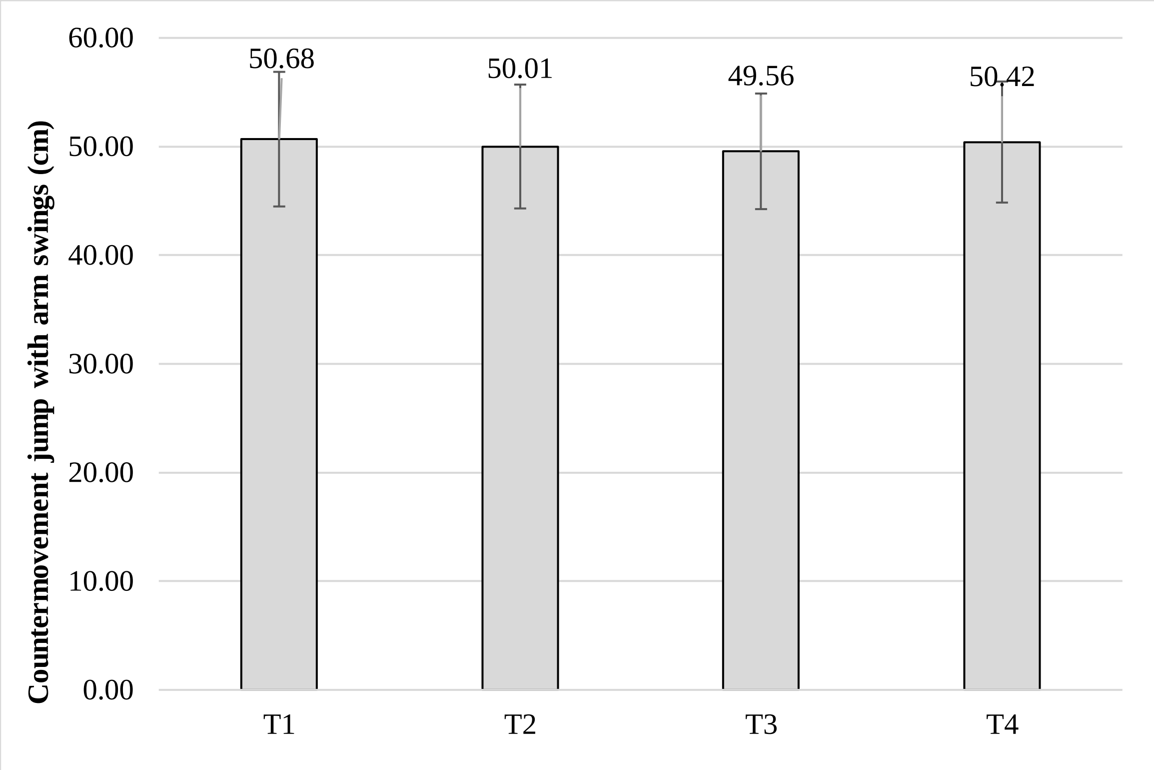

Figure 8. Countermovement jump with free arms swings (CMJ FA) test results (cm)

The results of Sprint 10 m running tests were similar throughout the tests from 1,77±0,06 s (T1) to 1,77±0,08 s (T4). There is no significant increase in result in Sprint 10 m running tests between T1 and T4 (Figure 9).

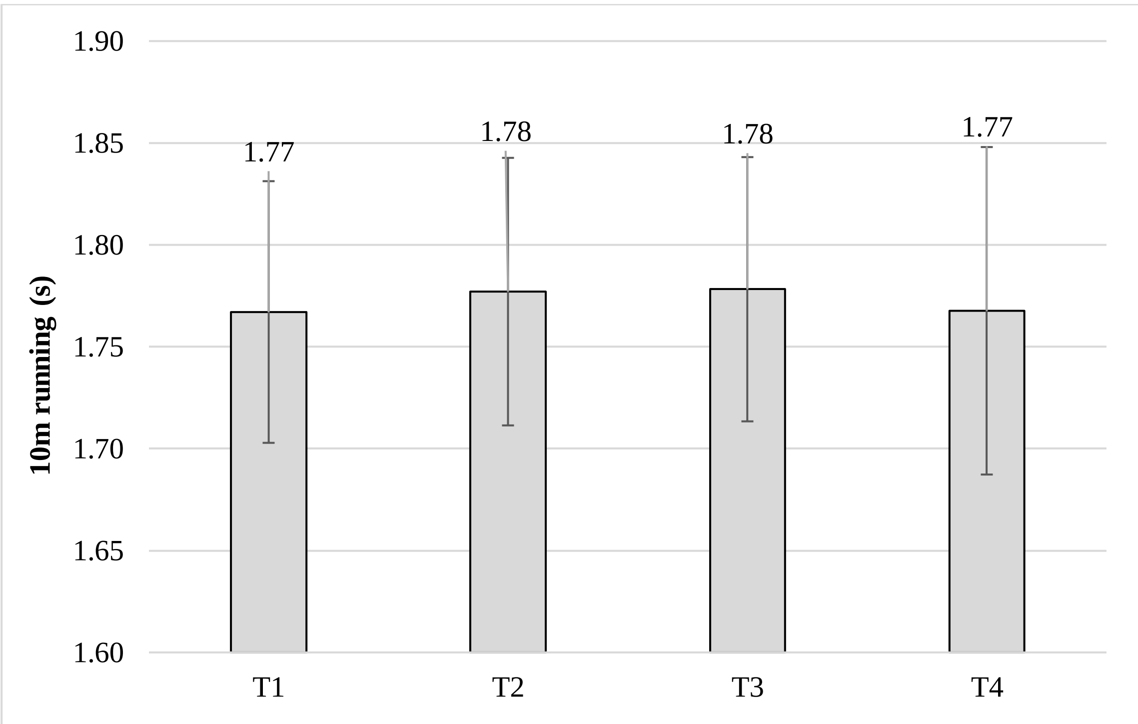

Figure 9. Sprint 10 m running test results (s)

The results of Sprint 20 m running tests were similar throughout the tests. Although the rates in the third test basketball players were slow down than in the other tests, however, there is no significant increase in result in Sprint 20 m running tests between T1 and T4 (Figure 10).

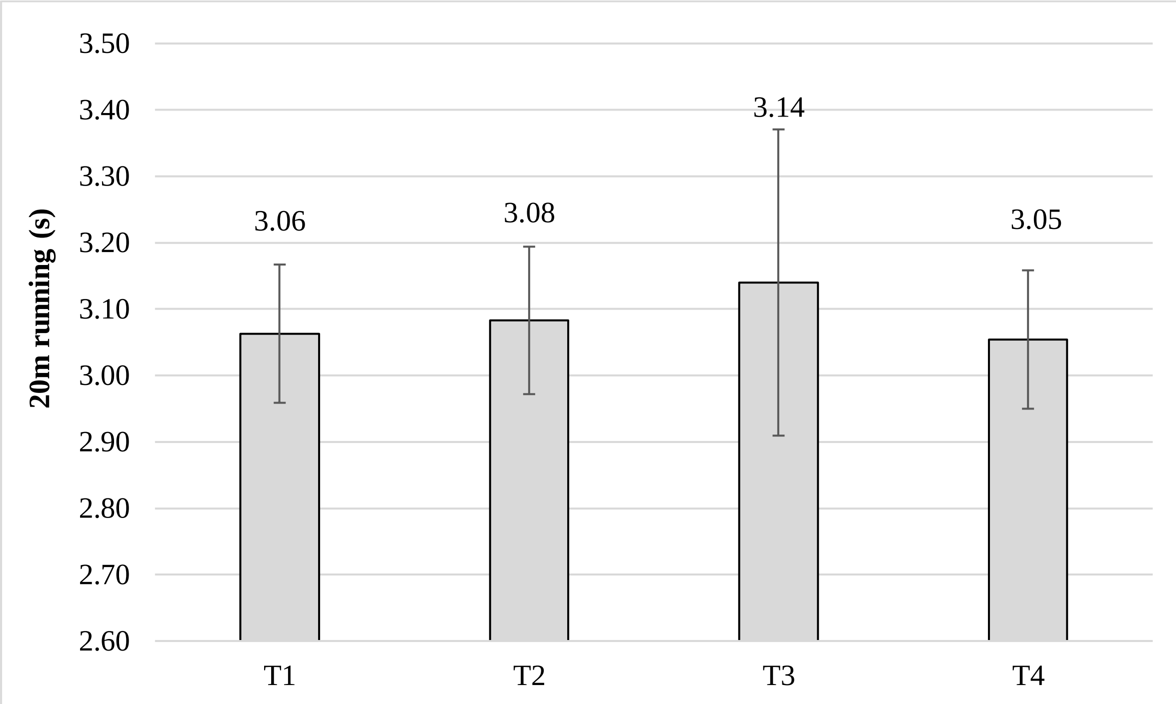

Figure 10. Sprint 20 m running test results (s)

The results changed during the Lane agility tests. Lane agility T1, T2 contradicts the law of normalcy Shapiro-Wilk test $p < 0.05$, only nonparametric criteria Wilcoxon Test versus the Sign Test can be used. The test revealed: significant increase in score between T1 and T4 Lane Agility $Z = -2.012$; $p < 0.05$ (Figure 11).

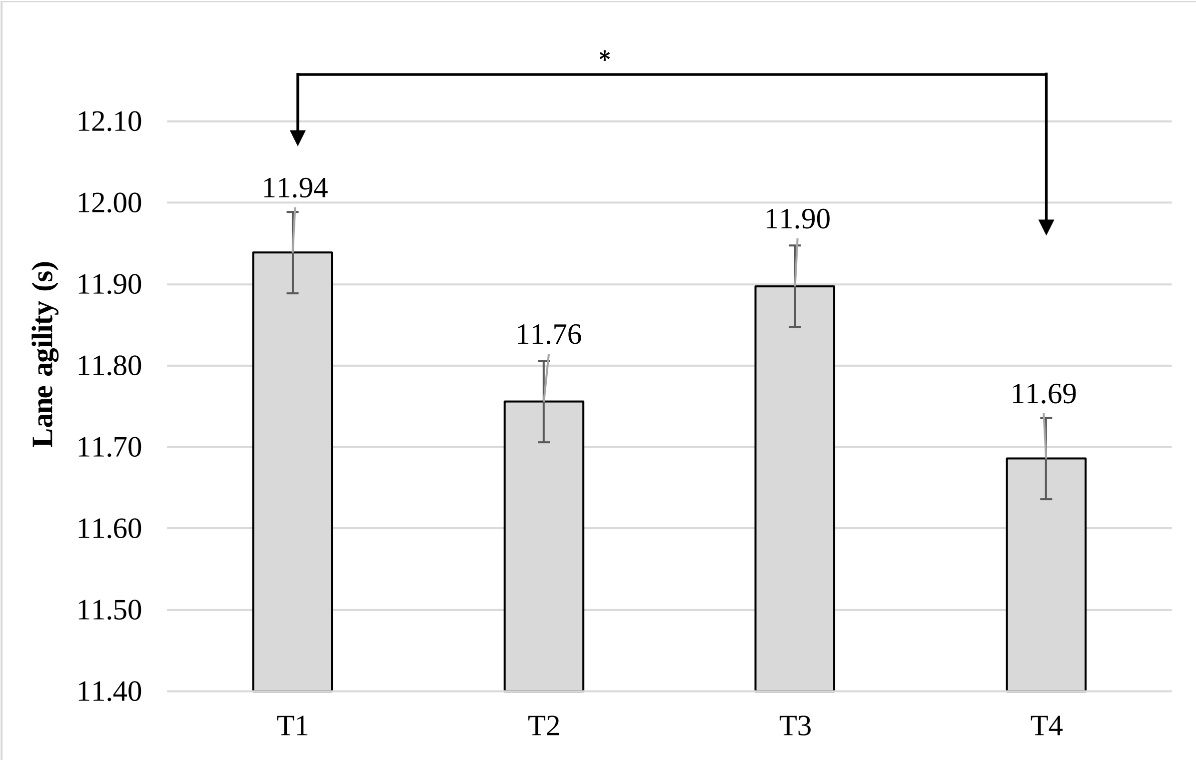

Figure 11. Lane agility test results (s)

In summary, it can be said that the results of testing for basketball players have changed insignificantly. Determinate significant increase in result CMJ 1.91 cm ($t = 2.73$; $p = 0.015$) between T1 and T4 test result. Significant increase in score between T1 and T4 Lane Agility $Z = –2.012$; $p < 0.05$.

3.2. The Relationships Between Vertical Jump, Speed, Agility And Performance

A positive correlation was found between CMJ and CMJ FA test results ($r=0.912$, $p<0.05$). A better CMJ test result is associated with a good CMJ FA test result (Figure 12).

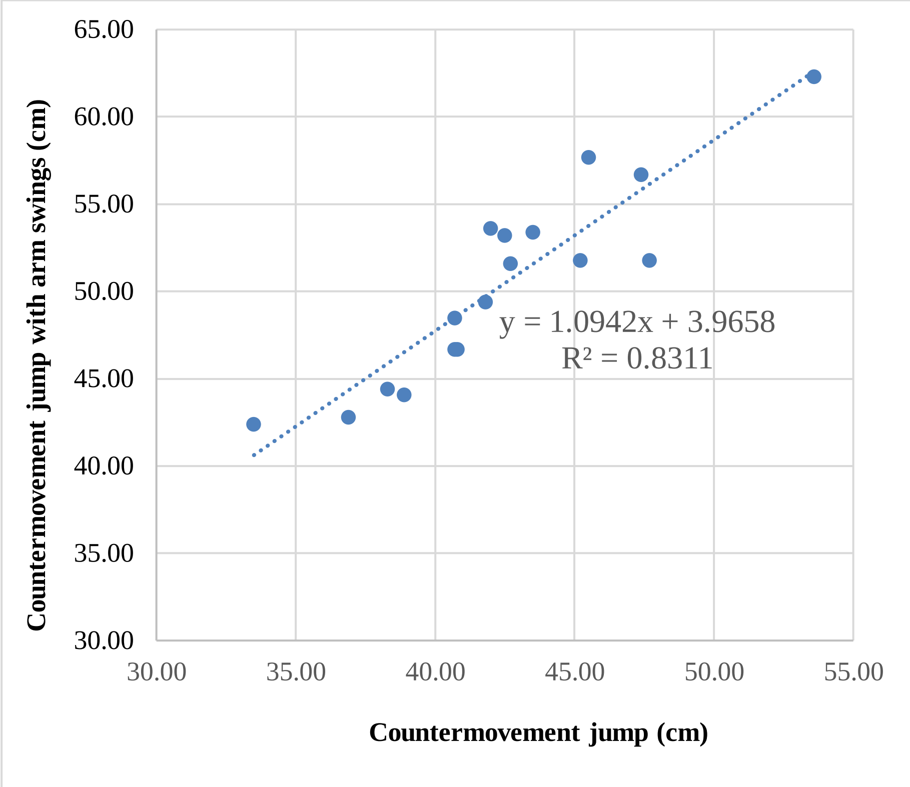

Figure 12. Relationship between CMJ and CMJ FA test results

An inverse correlation was found between CMJ and Sprint 10 m running test results ($r=-0.502$, $p<0.01$). The results show that the better the CMJ test of the basketball players, the slower the basketball players run. And vice versa if lower Sprint 10 results then performs better CMJ test (Figure 13).

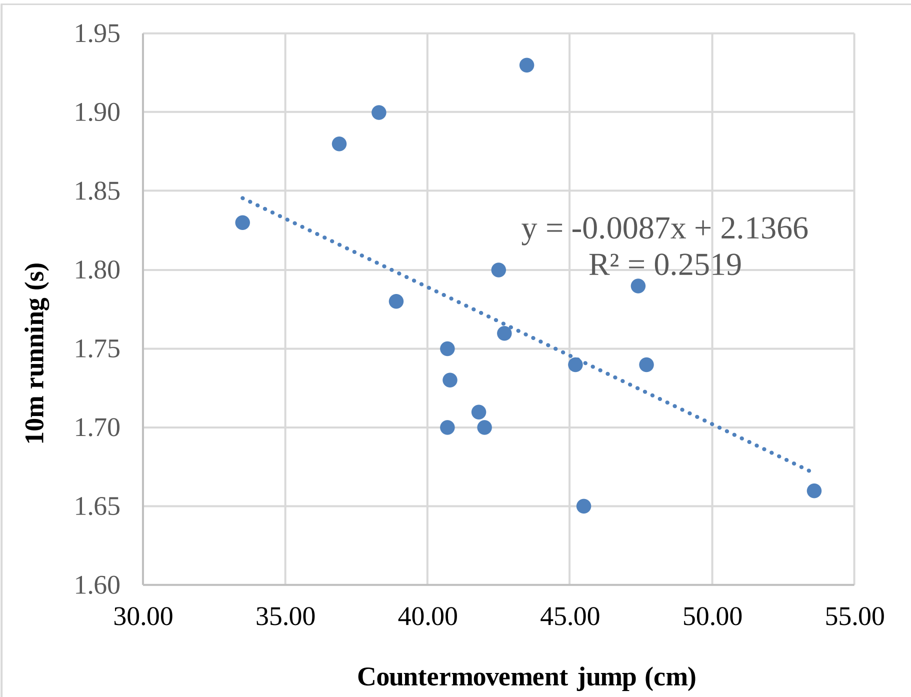

Figure 13. Relationship between CMJ and Sprint 10 m running test results

A similar trend as in the Sprint 10 test was found comparing the CMJ test results with the Sprint 20 results. An inverse correlation was found between CMJ and Sprint 20 m running test results ($r=-0.696$, $p<0.05$). The results show that the better the CMJ test of the basketball players, the slower the basketball players run. And vice versa if lower Sprint 20 results then performs better CMJ test (Figure 14).

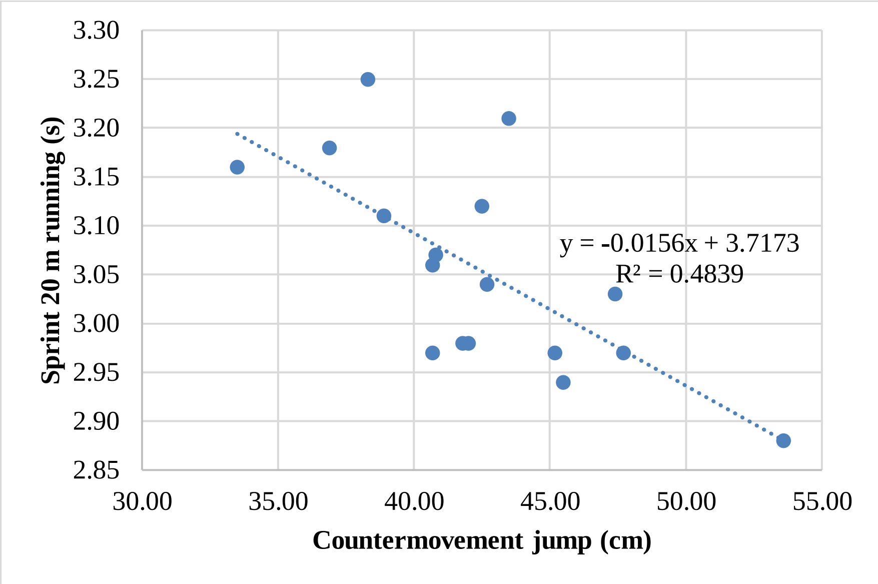

Figure 14. Relationship between CMJ and Sprint 20 m running test results

An inverse correlation was found between CMJ and Lane agility test results ($r=-0.626$, $p<0.01$). It was found that the higher the dexterity of basketball players, the worse he performs the CMJ test. And conversely, the better the CMJ results, the worse Lane agility test results (Figure 15).

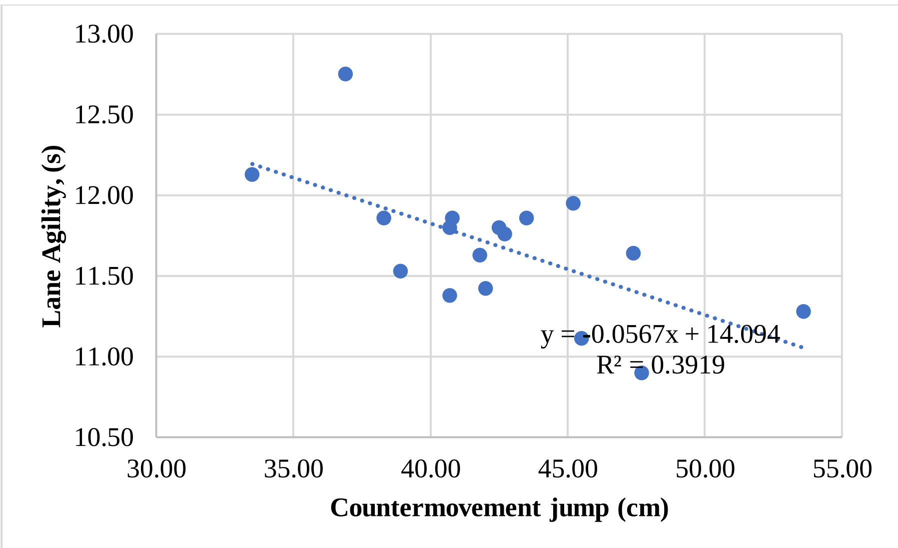

Figure 15. Relationship between CMJ and Lane agility test results

A comparison of CMJ FA and Sprint 10 results was found an inverse correlation (r=-0.484, p<0.05). The results show that the better the CMJ test of the basketball players, the slower the basketball players run and conversely (Figure 16).

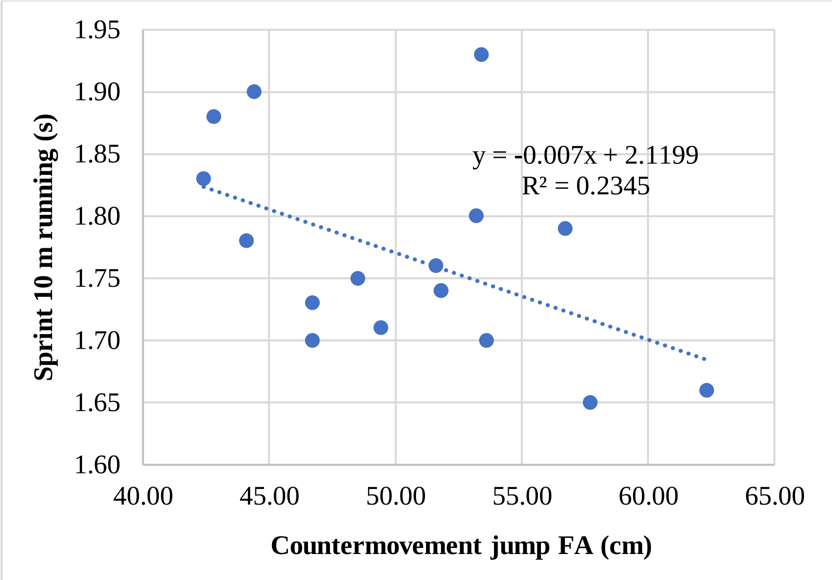

Figure 16. Relationship between CMJ FA and Sprint 10 m running test results

A similar trend as in the CMJ FA test was found comparing the Sprint 20 test results with the Sprint 10 results. An inverse correlation was found between CMJ FA and Sprint 20 m running test results (r=-0.636, p<0.05). The results show that the better the CMJ FA test of the basketball players, the slower the basketball players run and conversely (Figure 17).

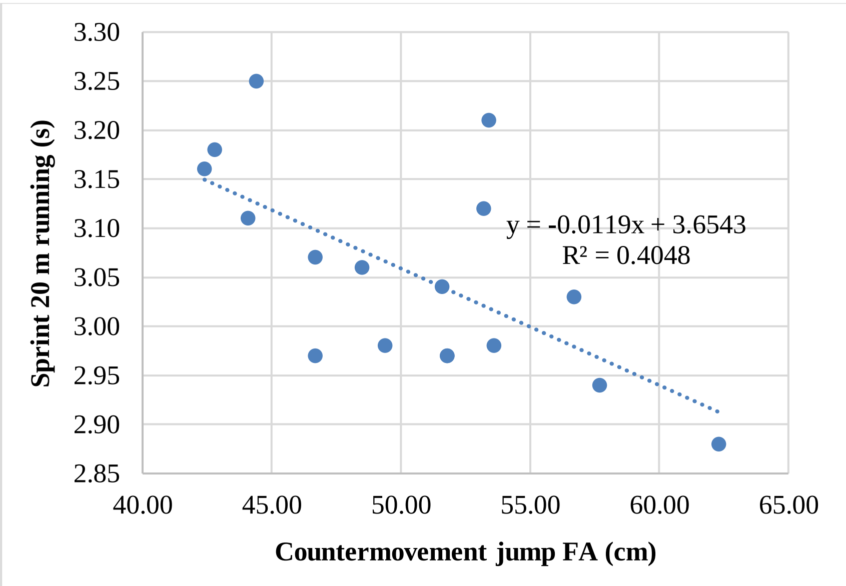

Figure 17. Relationship between CMJ FA and Sprint 20 m running test results

An inverse correlation was found between CMJ FA and Lane agility test results (r=-0.570, p<0.05). It was found that the higher the dexterity of basketball players, the worse he performs the CMJ FA test and conversely (Figure 18).

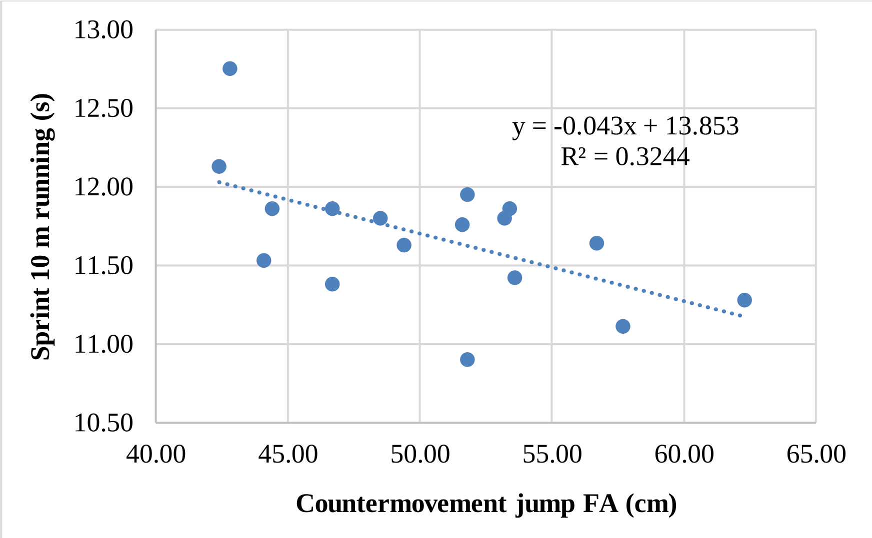

Figure 18. Relationship between CMJ FA and Lane agility test results

A direct relationship was found between the results of the Sprint 10 and Sprint 20 tests (r=0.936, p<0.05). If the basketball player runs fast in sprint 10 during the test, he will run fast in sprint 20 as well and conversely (Figure 19).

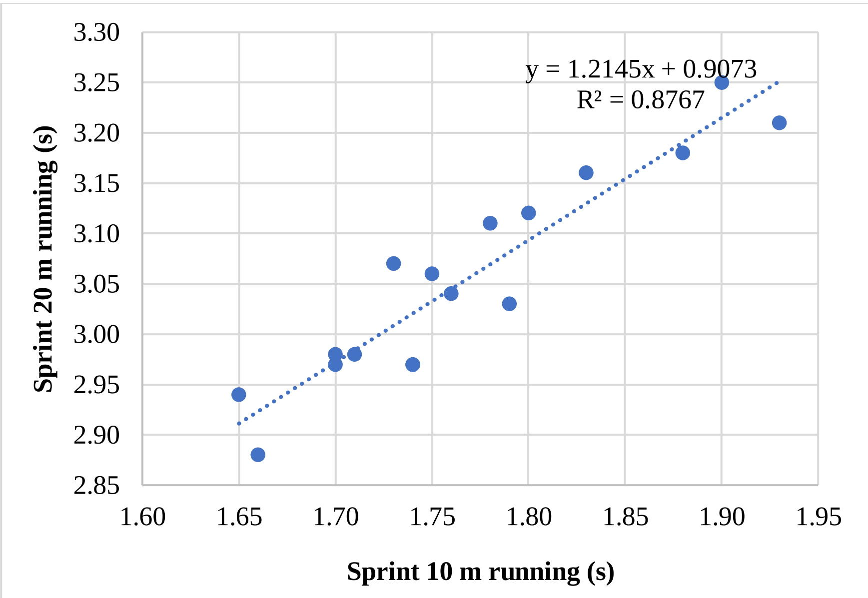

Figure 19. Relationship between Sprint 10 m and Sprint 20 m running test results

A positive relationship was found between Sprint 10 and Lane agility test results (r=0.662, p<0.01). It has been found that the more agile a basketball player is, the faster he runs and conversely (Figure 20).

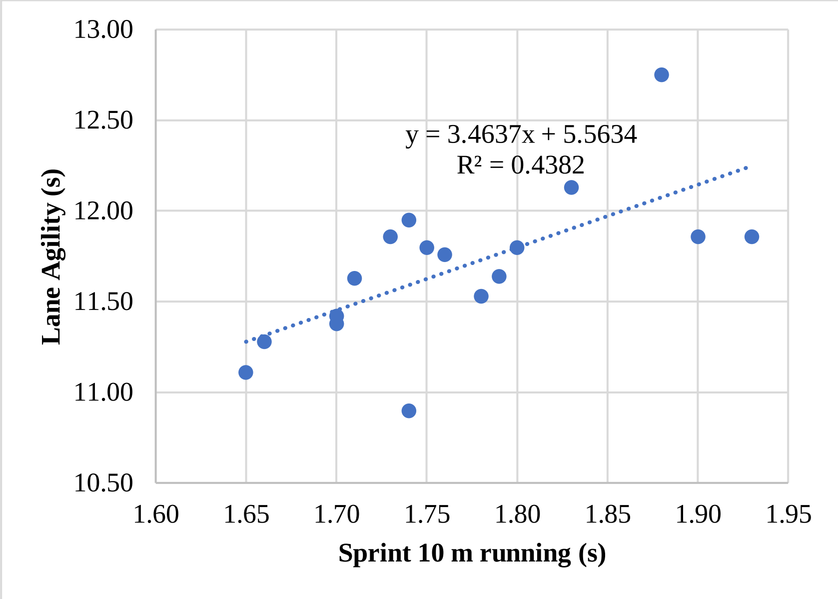

Figure 20. Relationship between Sprint 10 m running and Lane agility test results

A positive relationship was found between Sprint 10 and Lane agility test results also ($r=0.676$, $p<0.01$). It has been found that the more agile a basketball player is, the faster he runs and conversely (Figure 21).

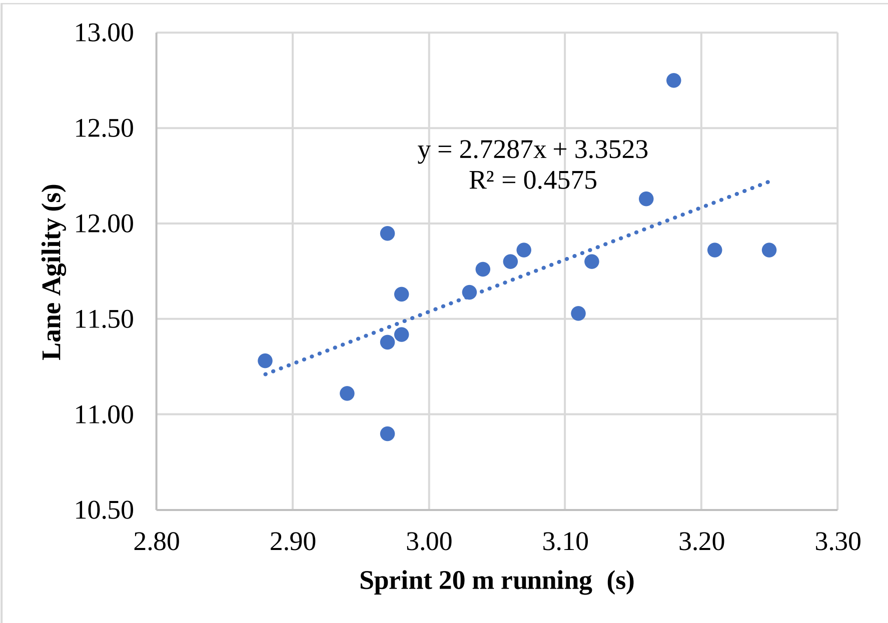

Figure 21. Relationship between Sprint 20 m running and Lane agility test results

Found that the above the basketball players jump, the faster they run or vice versa. As the dexterity score increases, the CMJ and CMJ FA score deteriorates or vice versa. As the dexterity score increases, the score of Sprint10 and Sprint20 deteriorates significantly or vice versa. It has been found that the more agile a basketball player is, the faster he runs and conversely.

3.3. The Relationships Between Tests And Body Sizes Indicators

A statistically significant relationship was found between CMJ scores and basketball players' body mass ($r=-0.519$, $p<0.05$). The higher the basketball player's body weight, the lower his CMJ test scores (Figure 22).

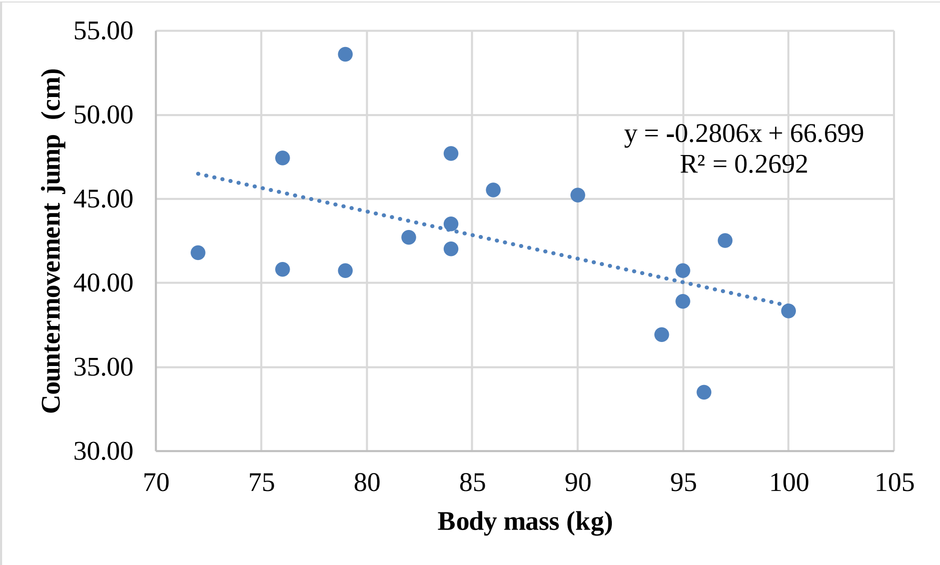

Figure 22. Relationship between CMJ test results and basketball players body mass

The same trend was found when comparing CMJ FA test results with basketball players' body weight ($r=-0.498$, $p<0.05$). The higher the basketball player's body weight, the lower his CMJ FA test scores (Figure 23).

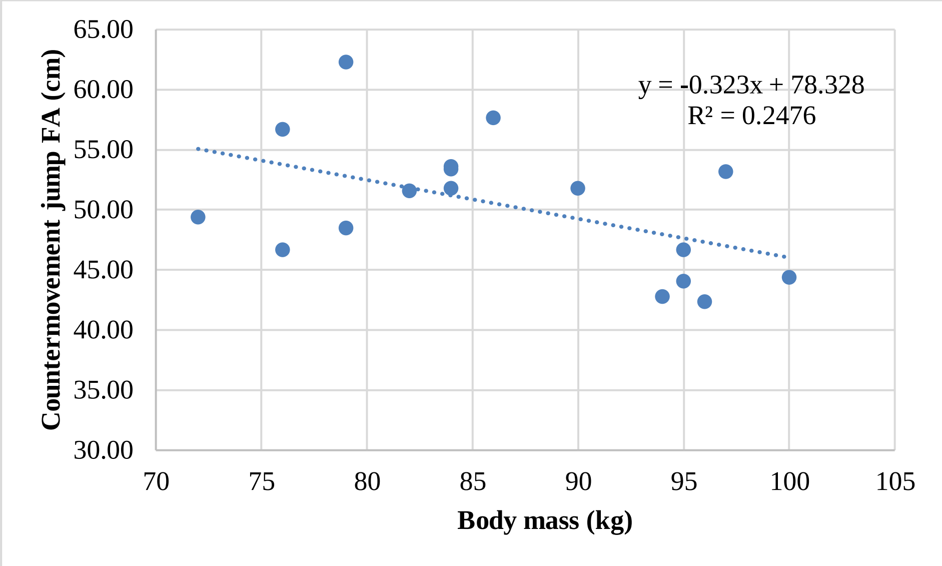

Figure 23. Relationship between CMJ FA test results and basketball players body weight

A relationship was found between the body weight of basketball players in Sprint 20 tests (r=0.510, p<0.05). It has been found that the higher the body mass of the basketball player, the slower he performs the Sprint 20 test (Figure 24).

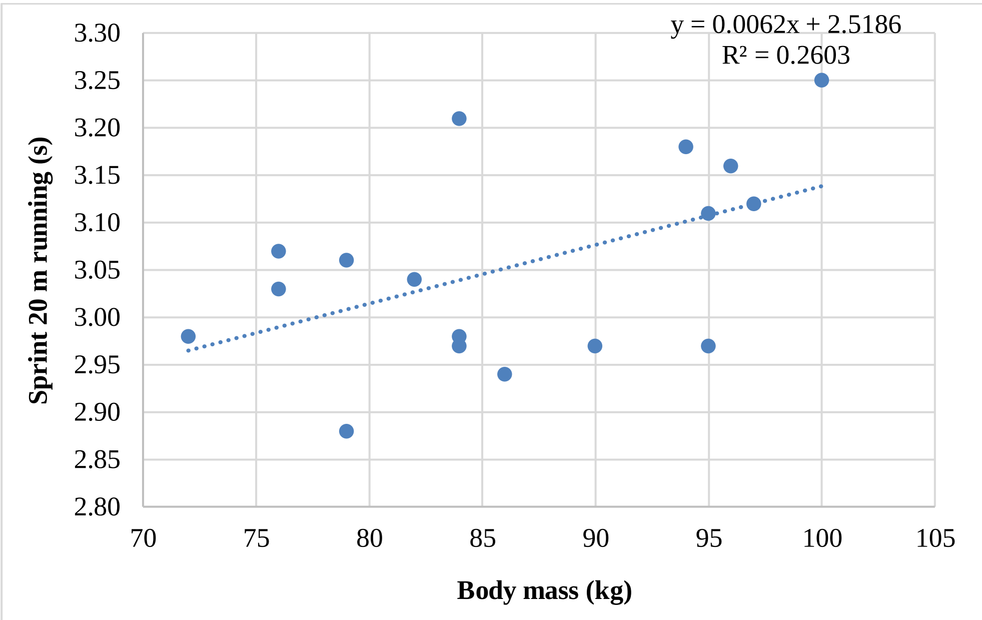

Figure 24. Relationship between Sprint 20 m running test results and basketball players body body weight

A relationship was found between the height of basketball players in Sprint 20 tests (r=0.527, p<0.05). It was found that the higher basketball player slower performs the Sprint 20 test (Figure 25).

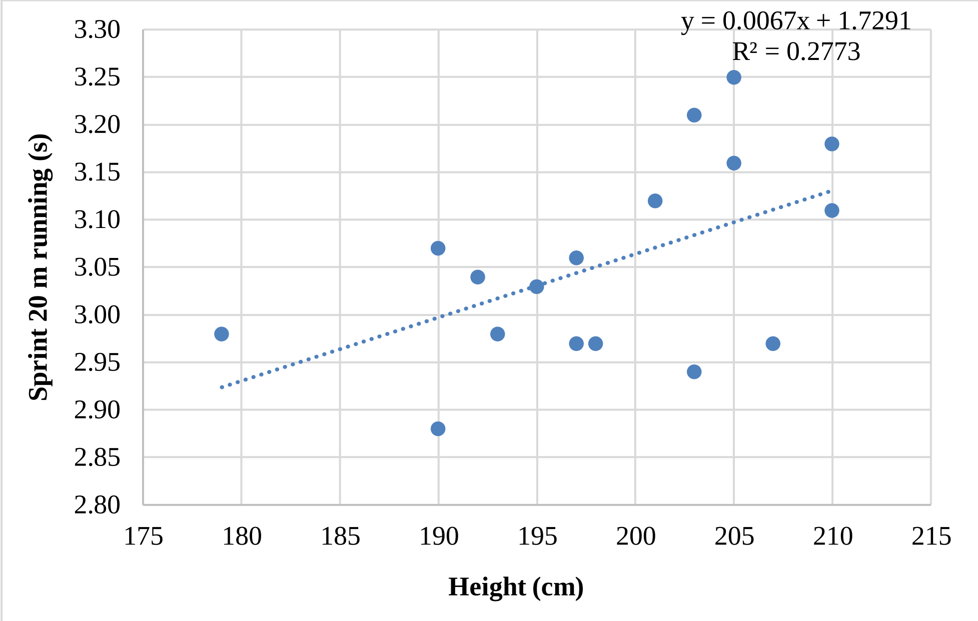

Figure 25. Relationship between Sprint 20 m running test results and basketball players height

A relationship was found between the height of basketball players in Sprint 10 tests (r=0.491, p<0.05). It was found that the higher basketball player, the slower performs the Sprint 10 test (Figure 26).

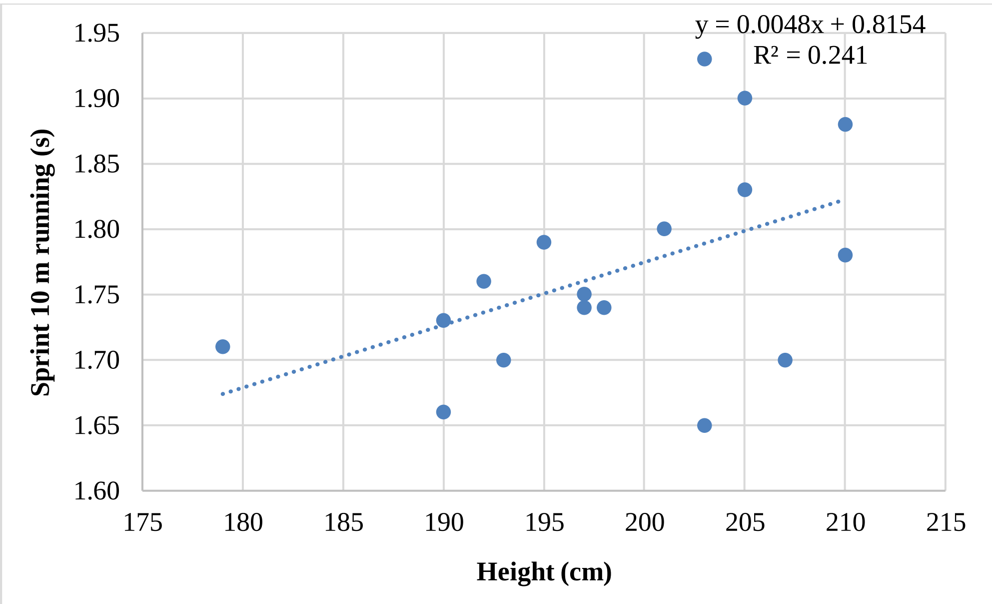

Figure 26. Relationship between Sprint 10 m running test results and basketball players height

Found that as the weight of the athletes decreases the jump result in CMJ and CMJ FA improves. As the height decreases the result of Sprint10 and Sprin20 improves. One possible reason for the lack of correlation between tests performance may be the different energy systems that each measure needs.

4. DISCUSSION

In basketball, during the game player must be able to continuously perform intermittent activities ranging from low to high intensity activity and/or recovery. High intensity intermittent activities such as jumps (rebounds, blocks, shots), change of direction, dribbling, sprints, screens and low-intensity activities such as walking, deceleration are necessary in order to succeed during basketball games. In order to do a training session or play a basketball games the preparation of the body is necessary (Pliauga et al, 2018).

Previous studies have examined jumping performance in basketball while comparing playing levels (performance levels). Koklu and his colleagues reported first-division Turkish players as being superior in CMJ performance than their second-division peers (40.6±4.7 and 36.0±5.0 cm, respectively), with no significant differences in squat-jump performance (37.8±5.7 and 34.7±5.7 cm, respectively) (Koklu et al, 2011). When compared three Tunisian national teams (under 18, under 20, and senior team) Abdelkrim et al. (2010) evidenced better CMJ achievement in older players (41.4±4.6, 49.1±5.9, and 49.7±5.8 cm, respectively), while Castagna et al. (2009) reported similar CMJ for Italian regional level juniors and seniors, (CMJ: 48.11±10.53 and 47.04±5.77 cm, respectively). However, all of these studies investigated standing vertical jumps, while running jumps are rarely examined although known to be highly specific and important in basketball. On this study CMJ test results were similar basketball players improved from 40,54±5,16 to 42,45±4,64.

However, Koklu et al. (2011) reported no significant differences in different types of vertical jump among three positions in basketball. Based on such research results, in this study did not classify the basketball players according to game positions.

Twenty high level basketball players were recruited for this study. Countermovement jump (CMJ) and 20 meters sprint were measured before the warm up, after the warm up and after each quarter of the simulated basketball games. It was found, that both anaerobic alactic and anaerobic alactic/lactic warm ups significantly increased CMJ, however the anaerobic alactic warm-up group which had muscle potentiation loads during the warm up routine showed better results in CMJ compered to anaerobic alaktic/lactic warm-up group ($p < 0.05$). Evaluation of the power reflecting tests results during the simulated basketball game showed that both CMJ and 20 meters sprint results were better in anaerobic alactic warm up group. These findings suggest, that anaerobic alactic warm-up with potentiating exercises is the most effective for basketball players. This type of warm-up increases the power reflecting tests results during the simulated games the most (Pliauga et al, 2018). Similar results were found in the CMJ and Sprint 20 tests as in the above study. An inverse correlation was found between CMJ FA and Sprint 20 m running test results (r=-0.636, p<0.05). The results show that the better the CMJ FA test of the basketball players, the slower the basketball players run and conversely.

Asadi (2016) study indicated significant relationship between CMJ and 20 m (r = -0.61) sprint performance in basketball players. Barr and Nolte (2011) found a significant correlation between jump performance and 10 m (r = 0.66). In this study found an inverse correlation was found between CMJ and Sprint 20 m running test results (r=-0.696, p<0.05) and an inverse correlation was found between CMJ and Sprint 10 m running test results (r=-0.502, p<0.01).

Muniz-Pumares (2016) founded that men consistently exhibit a greater anaerobic capacity than women, though the magnitude changes from about 20 to 100%, depending on the method used to determine anaerobic capacity. Only male basketball players were tested in this study, so it is not possible to compare how the test results differ between men and women.

The ability of basketball athletes to effectively sprint, turn, change direction, jump and land is highly related to an athlete's maximum strength. Previous research has reported measures of maximum strength to be strongly associated with superior vertical jump (r = 0.64–0.74) (Dawes, Marshall, Spiteri, 2016), sprint (r = 0.63–0.65) (Chaouachi et al, 2009) and change of direction (r = 0.79–0.89) (Spiteri et al, 2015) performances, regardless of sex. In this study, the test results were not related to the strength of the basketball players, but it was found that a statistically significant relationship was found between CMJ scores and basketball players' body weight (r=-0.519, p<0.05). The higher the basketball player's body weight, the lower his CMJ test scores.

Heishman et al (2018), when testing basketball players, men and women did not find a statistically significant difference between CMJ tests results. The countermovement jump (CMJ) is routinely used in athlete performance to quantify adaptions to training, as well as monitor neuromuscular readiness and fatigue. However, controversy remains in whether to incorporate an arm swing during the CMJ with arm swings or keep the hands placed on the hips. Incorporating the arms provides a higher degree of sport specificity that may yield improved reliability. In this study was found significant increase in result CMJ 1.91 cm (t = 2.73; p = 0.015) between the firts and the fourth test result.

Body height is very important for basketball players, particularly for centers and might be one of the reasons for not finding an association between strength and single sprint performance. Another important factor may be the different distances were used in sprint tests in previous studies (Alemdaroğlu et al., 2012). In this study a relationship was found between the height of basketball players in Sprint 10 tests ($r=0.491$, $p<0.05$). It was found that the higher basketball player the slower performs the Sprint 10 and the Sprint 20 test.

The heavier the body, the longer is the time (and/or greater force) needed to resist the forward momentum. Consequently, the superior running jump performance of lighter players over heavier players can be observed as a consequence of their lower body weight (Pehar et al, 2017). In this study found the higher the basketball player's body weight, the lower his CMJ and CMJ FA tests scores.

NCAA Division II basketball players Lane Agility (s) test results 11.24 ± 0.54 (Dawes, Marshall, Spiteri, 2016) similar like this study $11,69 \pm 0,42$ s. Vescovi, McGuigan (2008) said, that the reason of differences between studies could be the use of different agility tests.

In summary, the results of this study are similar to those of previous studies, but there are also studies with different results. This may be due to the choice of different tests, the timing of the test, the physical characteristics of the individual athletes or other factors.

CONCLUSIONS

1. This training programme gives the increase indicators of CMJ ($t = 2.73$; $p = 0.015$) test result and Lane Agility ($Z = –2.012$; $p < 0.05$) between T1 and T4, but not speed indicators ($p > 0.05$).
2. A correlation between agility and vertical jump indicators (was moderate relationships), as the agility increases, the indicators of the jump (CMJ and CMJ FA) deteriorates. A correlation between agility and speed indicators (was moderate relationships), as the agility increases, the speed result deteriorates.
3. The youth elite basketball players who are the lower body mass jump higher and run faster.

SUGGESTIONS

- All team coaches and tested basketball players should be informed about the tests results.
- Basketball players should be tested every month, 8-10 times during the season - it is possible to control the training process efficiently with more frequent testing.
- To monitor basketball players who achieve worse testing results and apply individual training programs to them.
- The positions of the basketball players should be taken into account in the tests comparisons.

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ANNEXES