Seasonal changes in physical capacities of elite youth basketball players

KESTUTIS MATULAITIS¹, DARIUS SIRTAUTAS², RASA KREIVYTĖ³, RAMŪNAS BUTAUTAS⁴
^{1,2,3,4}Department of Coaching Science, Lithuanian Sports University, Kaunas, LITHUANIA

Published online: November 30, 2021

(Accepted for publication November 15, 2021)

DOI:10.7752/jpes.2021.s6430

Abstract

The aim of this study was to investigate the differences in seasonal changes in physical capacities of elite youth basketball players during preparatory and competitive periods. A total of 17 elite youth male basketball players from second and third basketball leagues of Lithuania (age: 17.8 ± 1.3 years; height: 198.5 ± 8.2 cm; body mass: 86.4 ± 8.6 kg) voluntarily participated in this study. All of these players also play for youth national teams. The players underwent testing 4 times: before preparatory period, after preparatory period, after first competitive round and after second competitive round. For each player, stage, countermovement jump (CMJ), countermovement jump with free arms (CMJ FA), 10–20 m sprint and lane agility tests were performed. Descriptive analysis was performed using the mean of the count of the event and standard deviation. The reliability of differences between averages was determined in accordance with the Student criterion for independent samples (the normality of distribution was tested by applying the Shapiro–Wilk criterion). In the assessment of the reliability of the results, the difference was deemed to be statistically significant when $p < 0.05$ (95% reliability). All statistical tests were performed using the software package IBM SPSS version 23.0 for Windows. This study showed that in elite youth basketball players, there were seasonal changes between testing before preparatory period and after second round competitive period, i.e., there was an increase in the indicators of CMJ and lane agility ($p < 0.05$) but not in CMJ FA and 10–20 m sprint indicators. Physical fitness tests (10–20 m sprint test, CMJ, CMJ FA, and lane agility test) are essential for the development process of youth basketball players to allow coaches to determine whether players are developing in terms of physical fitness.

Keywords: preparatory period, competitive period, speed, countermovement jump, agility

Introduction

Basketball is an intermittent, physically demanding sport with many defensive and offensive actions, where changes in speed and direction are produced and where jumps are an integral part of the game (Ben Abdelkrim et al., 2007; Pojskić et al., 2015; Zarić et al., 2018; Mancha-Triguero et al., 2020). These requirements require good physical conditioning because it is essential to succeed in basketball (Stone & Kilding, 2009; Tyshchenko et al., 2018). Basketball is characterized as predominantly anaerobic sport, with elite basketball players often subjected to more than 2700 actions of intermittent characteristics such as walking, running, sprinting, and jumping. From the point of view of high-intensity actions, time–motion studies have reported that 28.5–49.1% of the actions are sprinting, which is considered to be one of the most required actions performed by the athletes. By observing the repetition of intermittent efforts in basketball, it is determined that power endurance appears to be an imperative component of athletic fitness because the ability to sustain the greatest power during various efforts can be crucial at decisive moments in the game (Gantois et al., 2017). Amani et al. (2016) have emphasized that anaerobic power and anaerobic capacity are essential factors for success in sport performance.

However, the demands vary depending on the age, level, and gender of the players (Latzel et al., 2018). 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 (Pojskić et al., 2015; Gantois et al., 2017). The correct general preparation of the players is directly related to both individual and team performance (Mancha-Triguero et al., 2019; Uludağ et al., 2021). When focusing on the physical preparation of the players, it is necessary that physical fitness can be evaluated, maintained and, if necessary, improved (Mancha-Triguero et al., 2019). Tests focusing on physical fitness are widely used in team sports to assess the progression of physical capacity in players within a season and long-term development period (Montgomery et al. 2010; Matulaitis et al., 2019). Ongoing testing of basketball players is expected to help optimize the training process and successfully develop professional players (Trninić et al., 2001; Matulaitis et al., 2019).

Previous studies identified physical field tests of motor abilities that can help trainers and scouts to make the best decisions during talent identification and development (Matulaitis et al., 2019). In this study, the physical fitness tests most commonly used by coaches were needed to optimize the training process.

It is unclear how the physical capacity preparation of elite youth basketball players varies because there are many games and practices during the preparatory and competition period. Once this is clarified, it will

be possible to determine the effectiveness of periodization and selection of the training process. However, there are few available studies on the physical fitness characteristics of elite youth basketball players (Köklü et al., 2011; Tyshchenko et al., 2018), especially on seasonal changes of physical capabilities during preparatory and competitive periods. The aim of this study was to investigate seasonal changes in physical capacities of elite youth basketball players during preparatory and competitive periods.

Methods

Subjects

This study included 17 elite youth basketball players from second and third basketball leagues of Lithuania (age: 17.8 ± 1.3 years; height: 198.5 ± 8.2 cm; body mass: 86.4 ± 8.6 kg), who voluntarily participated in this study. All of these players also play for youth national teams. The subjects were fully informed about applied procedures and the experimental risk, and written informed consent was obtained from all of them.

Testing Procedures

The testing sessions were performed during preparatory and competition periods. Anthropometry and physical fitness were measured 4 times, i.e., before preparation period (before PP) in mid-August, after preparation period (after PP) in mid-September, after first round competitive period (after FR) in mid-October and after second round competitive period (after SR) in mid-November. The selected players participated in all four tests. The subjects were tested at the same time of the day (after lunch between 15.00 and 18.00). Before testing, the subjects were informed about the testing and its sequence as well as about the significance of this research. The subjects performed a standard warm-up (similar to the one performed during practices) led by their coach 15 min before testing. First, the anthropometric characteristics were measured followed by physical fitness measurements: 10–20 m sprint test, countermovement jump (CMJ), countermovement jump with free arms (CMJ FA) and lane agility test. All players were familiar with the tests performed in this study.

Anthropometry

The subject's body mass was obtained to the nearest 0.1 kg using an electronic scale (Tanita, Tanita Corporation). Height without shoes was measured to the nearest 0.1 cm using a stadiometer (Martin, GPM SiberHegner).

Physical Testing

10 m and 20 m sprint test from a standing start. Straight line sprint time over 10 and 20 m was measured using infrared photoelectric cells (Microgate, Witty, Italy). This test evaluates horizontal power while performing a cyclical movement – sprints from a standing start. The starting position was standardized at a distance of 0.7 m behind the start line; the player stood with one foot (freely chosen by the player) forward. Each player performed 3 sprints from a high start, with 3–5 min of rest between runs. The best time was recorded (Gottlieb et al., 2014).

CMJ. Similar to CMJ FA, the subject started in the tall standing position, with feet placed at hip width to shoulder width apart and hands akimbo. Then, the subject was instructed to start with equal weight distribution on both force cells. A visual representation of weight distribution was displayed on a monitor in front of the participant to provide synchronized and integrated feedback, which allowed the participants to adjust their position so that equal quantities of body mass were distributed on each force cell at the start of the jump. The jumps were assessed using a portable device, called the OptoJump Next (Microgate, Bolzano, Italy), which is an optical measurement system that consists of transmitting and receiving bars. Then, the subjects dropped into the countermovement position to a self-selected depth, followed by a maximal effort vertical jump, and landed in an athletic position on the force cells. The subject reset to the starting position after each jump, and the procedure was repeated for a total of 5 jumps. Up to 20 s of rest time was allowed between jumps. After the jump, the players continued moving while waiting for the next test. The highest jump was selected for the test. If at any point the subjects removed their hands from their hips or exhibited excessive knee flexion once airborne, the jump was ruled invalid and repeated (Heishman et al., 2018).

CMJ FA. The subjects started in the tall standing position, with feet placed at hip width to shoulder width apart, but with hands free for movement. Then, the subjects were instructed to start with equal weight distribution on both force cells. A visual representation of weight distribution was displayed on a monitor in front of the participant to provide synchronized and integrated feedback, which allowed the subject to adjust their positioning so that equal quantities of body mass were distributed on each force cell at the start of the jump. The jumps were assessed using a portable device, called the OptoJump Next (Microgate, Bolzano, Italy), which is an optical measurement system that consists of transmitting and receiving bars. Then, the subjects dropped into the countermovement position to a self-selected depth, incorporating an arm swing in their most natural, self-selected manner, followed by a maximal effort vertical jump and landing in an athletic position on the force cells. The participants reset to the starting position after each jump, and the procedure was repeated for a total of 5 jumps. Up to 20 s of rest time was allowed between jumps. After the jump, the players continued moving while waiting for the next test. The highest jump was selected for the test. If at any point the subjects exhibited excessive knee flexion once air borne, the jump was ruled invalid and repeated (Heishman et al., 2018).

Lane agility test. The players started at the top left corner of the key at the free-throw line and ran 5.8 m to the baseline. Then, the players side shuffled 4.9 m to the right across the baseline before running backward

to the top right corner of the free-throw line. Then, the players side shuffled 4.9 m to the left where they touched the floor with their foot at a designated point and then immediately completed the same circuit in the opposite direction. Timing ceased when players reached the start position again. Time required to complete each trial was measured using a dual beam electronic system (TC-System, Brower Timing Systems, Draper, UT, USA). Each subject was allowed 3 attempts with the fastest time being recorded to the nearest 0.01 s. The lane agility test has been shown to be a reliable assessment of change in direction ability in basketball athletes (Brown, 2012).

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

Results

Players' characteristics and test performances are reported in Table 1. Figure 1 shows that the CMJ test indicators of elite youth basketball players before PP are 40.5 ± 5.2 cm and after SR are 42.5 ± 4.6 cm, which is a significant increase of +1.9 cm ($t = 2.73$; $p = 0.015$).

Table 1. Descriptive results of the physical performance of basketball players

Variable	Before PP	After PP	After FR	After SR	Before PP - After SR		
					P-value	T-value	Z-value
CMJ (cm)	40.54 ± 5.16	41.72 ± 4.21	41.46 ± 4.82	42.45 ± 4.64	0.015	2726.00	
CMJ FA (cm)	50.68 ± 6.19	50.01 ± 5.70	49.56 ± 5.32	50.42 ± 5.57	0.823	-0.265	
10 m (s)	1.77 ± 0.06	1.78 ± 0.07	1.78 ± 0.06	1.77 ± 0.08	0.966	0.043	
20 m (s)	3.06 ± 0.10	3.08 ± 0.11	3.14 ± 0.23	3.05 ± 0.10	0.638	-0.479	
Lane agility (s)	11.94 ± 0.61	11.76 ± 0.54	11.90 ± 0.49	11.69 ± 0.42	0.044		-2.012

Figure 1. Change in CMJ (cm) indicators of elite youth basketball players during preparatory and competitive periods. * $p < 0.05$

The CMJ FA test indicators were similar throughout the tests, i.e., before PP = 50.7 ± 6.2 cm and after SR = 50.4 ± 5.6 cm (Figure 2).

Figure 2. Change in CMJ FA (cm) indicators of elite youth basketball players during preparatory and competitive periods

The indicators of 10 m sprint tests were similar (Figure 3) throughout the tests, i.e., before PP = 1.77 ± 0.06 s and after SR = 1.77 ± 0.08 s. The indicators of 20 m sprint tests were similar throughout the tests. Although the rates of basketball players in the third test were lower than those in the other tests, there was no significant increase in the results of 20 m sprint tests.

Figure 3. Change in 10 m and 20 m sprint (s) indicators of elite youth basketball players during preparatory and competitive periods

The agility indicators of elite youth basketball players during preparatory and competitive periods fluctuated (Table 1, Figure 4). It was determined that the indicators before PP = 11.94 ± 0.61 and after PP = 11.76 ± 0.54 contradicted the laws of the Shapiro–Wilk test $p < 0.05$; therefore, only non-parametric criteria could be used in the Wilcoxon test versus the Sign test. A significant difference in indicators ($p < 0.05$; $Z = -2.012$) was indicated before preparatory and after second competitive periods.

Figure 4. Change in lane agility (s) indicators of elite youth basketball players during preparatory and competitive periods. * $p < 0.05$

Discussion

The main result of this research was that elite youth basketball players improved their CMJ and lane agility ($p < 0.05$) from the start of the preparatory period to the end of the competitive period. In contrast, there were no seasonal changes in CMJ FA, 10 m and 20 m sprints. Sprinting and jumping abilities are fundamental locomotive skills that form key aspects of athletic motor skill (Lloyd et al., 2015). The use of an effective countermovement is a distinguishing factor of skilled vertical jumping (Dowling & Vamos, 1993). The jump capacity and CMJ test indicators of examined basketball players improved. Some authors opted for the CMJ test as the gold standard (Pion et al., 2015; Calleja-González et al., 2016; Gomes et al., 2017; Ramos et al., 2018) that defies the jump capacity or lower limb strength (Ziv & Lidor, 2016). Strength indicators of examined basketball players matched those of their peers: USA (NCAA Division 1) – 35.77 cm (Heishman et al., 2018), Spain – 41.57 cm (Calleja-Gonzalez et al., 2016), Tunisian youth national team – 41.4 cm (Ben Abdelkrim et al., 2010) and Italian regional-level juniors – 48.11 cm (Castagna et al., 2009). Köklü et al. (2011) reported CMJ performance for the first division Turkish players – 40.6 cm and for the second division – 36.0 cm. CMJ FA is the most specific and similar to the technique used in sports practice; therefore, it is used for analysing jump capacity in basketball players where they imitate the natural action of jumping to make a rebound, which is one of the most common actions in a competition (Ibanez et al., 2008; Mancha-Triguero et al., 2020). The CMJ FA test indicators of youth basketball players surpassed those of other authors: USA (NCAA Division 1) – 44.5 cm (Heishman et al., 2018) and Spain – 47.07 cm (Calleja-González et al., 2016).

By analysing NBA players, Gonzalez et al. (2013) determined that greater playing time positively contributed to the increase of strength and jumping indicators. Because our examined players showed some

improvement (compared between the beginning and the end) in strength (CMJ FA, 10 m and 20 m sprint), it can be said that the amount of playing time was either too small or too big. To determine this, more detailed and longer-term studies with more players should be performed. If the amount of playing time was too large, the significantly unchanged strength indicators can be explained by findings of Montgomery et al. (2008), who stated that the indicators of speed, agility and change in direction tended to increase and the indicators of vertical jump tended to decrease if the player played a game a couple of days in a row. Such effect on the indicators can remain for up to 3 days.

Regarding the specific tests of speed, the 20 m sprint test is more preferable; while other researchers chose shorter distance tests such as the 10 m sprint test. The players examined in this study showed similar 20 m sprint test results compared to those of other authors: Spain – 3.04 s (Calleja-González et al., 2016) and first division Brazilian players – 3.16–3.24 s (Gomes et al., 2017). All researchers agree that to successfully compete, the players have to be agile because they need to perform a series of actions in the least possible amount of time and under the opposition of the rival team. Thus, agility is a quality that should be taken into account and trained in basketball players. The ability of basketball athletes to effectively sprint, turn, change direction, jump and land is highly related to an athlete's maximum strength (Ben Abdelkrim et al., 2010). The Lane agility test indicators of the players that we tested are similar to those of their peers, who were tested by other researchers: USA (NCAA Division 2) – 11.24 s (Dawes et al., 2016) and Serbian Junior Basketball League players – 11.47–11.90 s (Stojanović et al., 2019).

Conclusion

In summary, it was determined that it was difficult to develop fatigue-sensitive physical characteristics such as speed, agility and force speed. However, it may be possible considering the age of the players, games and training process. Of note, the level of development of all studied physical traits corresponded to good or very good fitness. However, compared to the preparatory period, it was determined that countermovement jump and lane agility test indicators significantly increased ($p < 0.05$) after the competitive period.

These tests are essential in the development process of youth basketball players to help coaches determine whether players are developing in terms of physical fitness. The obtained results will help coaches and physical fitness trainers to monitor their players.

References

- Amani, A.R. Esmaeili, H., Aeinparast, Z. & Tari, F. (2016). Effect of Different Warm-up Methods on Anaerobic Power in Young Women. *Annals of Applied Sport Science*, 4(1), 17–20. DOI:10.7508/aass.2016.01.004
- Ben Abdelkrim, N., Castagna, C., Jabri, I., Battikh, T., El Fazaa, S. & El Ati, J. (2010). Activity profile and physiological requirements of junior elite basketball players in relation to aerobic-anaerobic fitness. *J Strength Cond Res*, 24(9), 2330–2342. DOI:10.1519/JSC.0b013e3181e381c1
- Ben Abdelkrim, N., El Fazaa, S. & El Ati, J. (2007). Time-motion analysis and physiological data of elite under 19-year-old basketball players during competition. *Br. J. Sports Med*, 41(2), 69–75. DOI:10.1136/bjsm.2006.032318
- Brown, A.E. (2012). The reliability and validity of the lane agility test for collegiate basketball players. *MS in Human Performance*. <http://digital.library.wisc.edu/1793/62353>
- Calleja-González, J., Mielgo-Ayuso, J., Lekue, J.A., Leibar, X., Erauzkin, J., Jukic, I., Ostojic, S.M., Delextrat, A., Sampaio, J. & Terrados, N. (2016). The Spanish “Century XXI” academy for developing elite level basketballers: design, monitoring and training methodologies. *Phys Sportsmed*, 44(2), 148–157. DOI:10.1080/00913847.2016.1168270
- Castagna, C., Chaouachi, A., Rampinini, E., Chamari, K. & Impellizzeri, F. (2009). Aerobic and explosive power performance of elite Italian regional-level basketball players. *J Strength Cond Res*, 23(7), 1982–1987. DOI:10.1519/JSC.0b013e3181b7f941
- Dawes, J., Marshall, M. & Spiteri, T. (2016). Relationship between pre-season testing performance and playing time among NCAA DII basketball players. *Sport Exerc Med Open J*, 2(2), 47–54. DOI:10.17140/SEMOJ-2-138
- Dowling, J. & Vámos, L. (1993). Identification of kinetic and temporal factors related to vertical jump performance. *J Appl Biomech*, 9(2), 95–110. DOI:10.1123/jab.9.2.95
- Gantois, P., Aidar, F.J., De Matos D.G., De Souza, R.F., Da Silva L.M., De Castro K.R., De Medeiros, R.C. & Cabral, B.G. (2017). Repeated sprints and the relationship with anaerobic and aerobic fitness of basketball athletes. *Journal of Physical Education and Sport*, 17(2), 910–915. DOI:10.7752/jpes.2017.02139
- Gomes, J.H., Rebello-Mendes, R., Almeida, M.B., Zanetti, M.C., Leite, G.D. & Júnior, A.J. (2017). Relationship between physical fitness and game-related statistics in elite professional basketball players: regular season vs. playoffs. *Motriz: rev. educ. fis*, 23(2), 1–7. DOI:https://doi.org/10.1590/s1980-6574201700020004
- Gonzalez, A.M., Hoffman, J.R., Rogowski, J.P., Burgos, W., Manalo, E., Weise, K., Fragala, M.S. & Stout, J.R. (2013). Performance changes in NBA basketball players vary in starters vs. nonstarters over a competitive season. *J Strength Cond Res*, 27(3), 611–615. DOI:10.1519/JSC.0b013e31825dd2d9

- Gottlieb, R., Eliakim, A., Shalom, A., Iacono, A.D. & Meckel, Y. (2014). Improving anaerobic fitness in young basketball players: Plyometric vs. specific sprint training. *J Ath Enhance*, 3(3). DOI:10.4172/2324-9080.1000148
- Heishman, A.D., Daub, B.D., Miller, R.M., Freitas, E., Frantz, B.A. & Bembien, M.G. (2018). Countermovement jump reliability performed with and without an arm swing in NCAA division I intercollegiate basketball players. *J Strength Cond Res*, 34(2), 546–558. DOI:10.1519/JSC.0000000000002812
- Ibáñez, S.J., Sampaio, J., Feu, S., Lorenzo, A., Gómez, M.A. & Ortega, E. (2008). Basketball game-related statistics that discriminate between teams' season-long success. *Eur J Sport Sci*, 8(6), 369–372. DOI:10.1080/17461390802261470
- Köklü, Y., Alemdaroglu, U., Koçak, F.Ü., Erol, A.E. & Findikoglu, G. (2011). Comparison of chosen physical fitness characteristics of Turkish professional basketball players by division and playing position. *J. Hum. Kinet*, 30, 99–106. DOI:10.2478/v10078-011-0077-y
- Latzel, R., Hoos, O., Stier, S., Kaufmann, S., Fresz, V., REim, D. & Beneke, R. (2018). Energetic profile of the basketball exercise simulation test in junior elite players. *Int. J. Sports Physiol. Perform*, 13, 810–815. DOI:10.1123/ijsp.2017-0174.
- Lloyd, R.S., Oliver, J.L., Faigenbaum, A.D., Howard, R., De Ste Croix, M.B., Williams, C.A. & Myer, G.D. (2015). Long-term athletic development- part 1: A pathway for all youth. *J Strength Cond Res*, 29(5), 1439–1450. DOI:10.1519/jsc.0000000000000756
- Mancha-Triguero, D., Garcia-Rubio, J., Antúnez, A. & Ibáñez, S.J. (2020). Physical and physiological profiles of aerobic and anaerobic capacities in young basketball players. *Int. J. Environ. Res. Public Health*, 17 (4), 1409. DOI:10.3390/ijerph17041409
- Mancha-Triguero, D., García-Rubio, J., Calleja-González, J. & Ibáñez, S.J. (2019). Physical fitness in basketball players: A systematic review. *J. Sports Med. Phys. Fit*, 59, 1513–1525. DOI:10.23736/S0022-4707.19.09180-1
- Matulaitis, K., Skarbalius, A., Abrantes, C., Gonçalves, B. & Sampaio J. (2019). Fitness, technical, and kinanthropometrical profile of youth Lithuanian basketball players aged 7–17 years old. *Front Psychol*, 10(1677). DOI:10.3389/fpsyg.2019.01677
- Montgomery, P.G., Pyne, D.B., Hopkins, W.G. & Minahan, C.L. (2008). Seasonal progression and variability of repeat-effort line-drill performance in elite junior basketball players. *J Sports Sci*, 26(5), 543–550. DOI:10.1080/02640410701654298
- Montgomery, P.G., Pyne, D.B. & Minahan, C.L. (2010). The physical and physiological demands of basketball training and competition. *Int J Sports Physiol Perform*, 5(1), 75–86. DOI:10.1123/ijsp.5.1.75
- Pion, J., Segers, V., Fransen, J., Debuyck, G., Deprez, D., Haerens, L., Vaeyens, R., Philippaerts, R. & Lenoir, M. (2015). Generic anthropometric and performance characteristics among elite adolescent boys in nine different sports. *Eur J Sport Sci*, 15(5), 357–366. DOI:10.1080/17461391.2014.944875
- Pojksic, H., Šeparović, V., Užičanin, E., Muratović, & M. Mačković, S. (2015). Positional Role Differences in the Aerobic and Anaerobic Power of Elite Basketball Players. *J Hum Kinet*, 49, 219–227. DOI:10.1515/hukin-2015-0124
- Ramos, S., Volossovitch, A., Ferreira, A.P., Barrigas, C., Fragoso, I. & Massuça, L. (2020). Differences in maturity, morphological, and fitness attributes between the better- and lower-ranked male and female U-14 Portuguese elite regional basketball teams. *J Strength Cond Res*, 34(3), 878–887. DOI:10.1519/JSC.0000000000002691
- Stojanović, E., Aksović, N., Stojiljković, N., Stanković, R., Scanlan, A.T. & Milanović, Z. (2019). Reliability, usefulness, and factorial validity of change-of-direction speed tests in adolescent basketball players. *J Strength Cond Res*, 33(11), 3162–3173. DOI:10.1519/JSC.0000000000002666
- Stone, N.M. & Kilding, A.E. (2009). Aerobic conditioning for team sport athletes. *Sports Med*, 39(8), 615–642. DOI:10.2165/00007256-200939080-00002
- Trninić, S., Marković, G. & Heimer, S. (2001). Effects of developmental training of basketball cadets realised in the competitive period. *Coll Antropol*, 25(2), 591–604
- Tyshchenko, V., Hnatchuk, Y., Pasichnyk, V., Bubela, O.O. & Semeryak, Z. (2018). Factor analysis of indicators of physical and functional preparation of basketball players. *Journal of Physical Education and Sport*, 18(4), 1839–1844. DOI:10.7752/jpes.2018.s4269
- Uludağ, S., Dorak, F., Vurgun, N., Yüzbaşıoğlu, Y. & Ateş, E. (2021). Effects of 10 weeks of imagery and concentration training on visual focus and free-throw performance in basketball players. *Journal of Physical Education and Sport*, 21(4), 1761–1768. DOI:10.7752/jpes.2021.04223
- Zarić, I., Dopsaj, M. & Marković, M. (2018). Match performance in young female basketball players: relationship with laboratory and field tests. *Int. J. Perform. Anal. Sport*, 18(1), 90–103. DOI:10.1080/24748668.2018.1452109
- Ziv, G. & Lidor, R. (2009). Physical attributes, physiological characteristics, on-court performances and nutritional strategies of female and male basket-ball players. *Sports Med*, 39(7), 547–568. DOI:10.2165/00007256-200939070-00003