ANAEROBIC CAPACITY ASSESSMENT OF JUNIOR BASKETBALL PLAYERS AFTER THE PANDEMIC LOCKDOWN IN ROMANIA

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Abstract. In the context of the pandemic period, basketball competitions have undergone changes in their organisational structure, so playing games in the form of a “bubble” tournament required adequate training. Due to the rapid pace of play during the “bubble” competitions, junior basketball players need to have very good anaerobic and aerobic capacity. Intensification of the competitive effort by increasing the speed of movement and execution, making fast breaks, performing bouncing passes and throws to the basket, fighting to recover the ball and using the active defence (pressing) all over the court imposes high demands on the body at the somatic and vegetative levels. The purpose of the present study is to assess the anaerobic capacity of junior players (U16) in the pre-competitive period, given that their training was interrupted between March and September 2020 by the legislative norms on sports activity due to the situation of the COVID-19 pandemic in Romania. The ascertaining study was conducted in January 2021 on the CSU Știința Bucharest team players aged 15-16 years. The tests applied to assess their anaerobic capacity consisted of Countermovement Jump (CMJ) and acceleration speed (5 m, 10 m and 15 m). The data were collected using the computerised Optojump and Tag Heurer - Chronoprinter 520 techniques.

Keywords: anaerobic capacity, basketball, junior, pandemic.

Introduction

The rapid spread of COVID-19 forced the governments of several states to take measures to interrupt or cancel several sports competitions from February to March 2020. Starting with the Olympic Games to the professional basketball championships within the National Basketball Association (NBA) or EuroLeague Basketball, all were affected by SARS-CoV-2 in one way or another.

These changes and restrictions imposed by EU states (and not only) had consequences on the training of top-level athletes, both juniors and seniors (Peña et al., 2021; Guicciardi & Pazzona, 2020; Lesser & Nienhuis, 2020).

The European Parliament Resolution of 10 February 2021 on the Impact of COVID-19 on Youth and Sport (European Parliament, 2021) emphasises that the constraints of the COVID-19 pandemic and the lack of sufficient opportunities for regular training and practice have been detrimental to athletes’ progression and development. It also mentions that event organisers, coaches and athletes themselves should be informed about the possible implications of the prolonged lack of intensive training. The same document asks for cooperation among sports institutions and organisations to support projects and concepts whose focus is on regaining the capabilities lost by athletes.
In Romania, as in other European countries, the lockdown period meant distancing athletes from daily training and competitions. Recent research (Andreato et al., 2020; Jukic et al., 2020; Huyghe et al., 2020) shows that lack of training or limited training time leads to loss of performance capability, reduces the competitiveness of athletes and decreases their physical, technical and psychological abilities (Fiorilli et al., 2021; Gilat & Cole, 2020).

The impact of stopping professional sports activity was undoubtedly negative, besides the already known restrictions and repercussions, but other effects might also be identified in the future. There were changes in the schedule and content of the daily training of elite athletes, changes in competition calendars and postponements of national and international competitions, which led to the adaptation and modification of everything related to approaching professional sport. Each of the factors involved in sports performance (athletes, collaborators, spectators, etc.) had to redefine in order to minimise the negative effects of both the COVID-19 pandemic and the restrictions imposed to prevent its spread.

**Problem statement**

In the context of the pandemic lockdown, athletes were affected because they had to take a forced break. This change had a negative impact on the quality of training, with athletes having to adapt to the new training conditions in which distancing was mandatory. A significant reduction in the number of training sessions may mean, for junior athletes, the loss of competitiveness when returning to competition. Thus, sports specialists and scientists are challenged to help athletes regain the physical, technical and mental capabilities they had before the lockdown period.

Understanding the phenomenon of adapting/readjusting the body to the specific effort is essential for a basketball coach. The lack of adaptation to the real situation or a wrong direction of the training process leads to major malfunctions between the motor potential and ability of players to express themselves technically and tactically on the field. During the pandemic, these malfunctions were largely due to the lack of a systematic structure of the training year able to comply with the regularities of functional adaptations and the transfer of general training exercises to specific ones according to the dynamics of competitive effort.

Anaerobic contribution is known to be important for tactical movements (i.e., defensive/offensive transitions) and technical actions (i.e., shooting, jumping, blocking, passing or staging) performed in basketball (Hadzhiev & Dzimbova, 2020; Castagna et al., 2010; Delextrat & Cohen, 2008; Hoffman et al., 1999).

In view of the above, this paper aims to assess the anaerobic capacity of junior athletes in the post-lockdown period.

The game of basketball is complex in nature and requires a multitude of basic motor skills that intertwine with each other.

Basketball involves maximum intensity exercise that alternates with short periods of submaximal exercise, which is variable in intensity and duration, with short interruptions, and the basic motor skills required are agility, speed, strength and endurance (Leonte et al., 2019). Basketball players need to move quickly using their core strength and lower body muscles (Ghiţescu et al., 2014). Strength is increasingly required in sports games, and basketball uses speed-strength (for basket throws, pressing defence actions) (Moanţă et al., 2014).
Due to the game pace with quick bouts of activity and short recovery bouts, players need to have very good, even excellent anaerobic and aerobic capacity because the demand on their cardiovascular and respiratory systems is very high (Predescu & Ghițescu, 2001).

Modern basketball is characterised by a tendency to intensify the competitive effort by increasing the speed of movement and execution, making fast breaks, performing bouncing passes and throws to the basket, fighting to recover the ball and using the active defence (pressing) all over the court, which imposes high demands on the body at the somatic (nervous system, muscle-ligament system, analysers) and vegetative (circulation, breathing, thermoregulation, energy expenditure) levels. This extremely high stress leads to the onset of fatigue, particularly in the central nervous system, which results in a decreased ability to focus and the appearance of elementary mistakes.

The stress placed on the central nervous system is considerable throughout the game of basketball. Cortical hyperexcitability is accompanied by an increase in reaction speed. Excessive emotiveness and frequent score changes can trigger the exacerbation of cortical excitability, which leads to mistakes and early onset of cortical fatigue manifested by reduced coordination. Recent studies (Leonte et al., 2020) have shown that the game of basketball positively influences the development of emotional intelligence.

The strain on the cardiovascular system during the basketball game is intense and is reflected in the pronounced increase in heart rate (up to 150-160 beats per minute) and blood pressure (around 160-180/80-90 mmHg). High emotions, especially in less trained players, increase the reactivity of the cardiovascular system.

Respiratory function is subject to stresses of varying intensity. During the basketball game, pulmonary respiration goes through various changes, from total apnoea to an increase to very high values of respiratory volume per minute. Oxygen debt is usually not too high and can be paid off in the moments of respite offered by interruptions or some defensive actions. Tissue respiration is intensified throughout the game and a few hours after its end.

The physiology of aerobic and anaerobic energy systems is complex. It is important to have a basic understanding of energy sources in order to maximise the training (Table 1).

<table>
<thead>
<tr>
<th>Anaerobic ATP-PC</th>
<th>Anaerobic glycolysis</th>
<th>Aerobic</th>
</tr>
</thead>
<tbody>
<tr>
<td>(0-10 sec)</td>
<td>(10 sec - 3 min)</td>
<td>Over 3 min</td>
</tr>
<tr>
<td>Breaks in rhythm, throws</td>
<td>Continuous transition</td>
<td>Game duration</td>
</tr>
</tbody>
</table>

The anaerobic threshold is closely related to high-intensity and short-term exercise, which enhances its potential. Depending on what is intended to be developed, the power or capacity of this process, the nature of actions will differ significantly. The anaerobic threshold defines the upper limit of the lactate balance and represents the amount of blood lactate (mmol/L), the dominant source of energy being the hydrocarbons that are metabolised both aerobically and anaerobically.

In the anaerobic alactacid process, regardless of the support activity used, the exercise intensity must always be maximal, therefore correspond to the highest index in absolute value that the athlete is able to achieve. The speed of movement is artificially improved by using
facilitative situations such as easing the body weight. Resistance to movement is accentuated to cause muscle contractions of higher intensity compared to the usual maximum values, i.e., isometric exercises or successive eccentric contractions. If the intensity must be maximal, then the duration of actions will always be between three and seven seconds. Below three seconds, the short exercise duration makes the demand of the alactacid process insufficient, and over seven seconds, the effect is no longer limited to this process. The need to provide maximum effort to develop the anaerobic alactacid power has a decisive effect on the characteristics of recovery. After an anaerobic alactacid exercise, a recovery time lasting between one minute and 30 seconds and 3 minutes is required to allow the return to the steady state. The duration of recovery should not be excessively prolonged because the consequences would be a decrease in the level of arousal, which would affect the quality of the next exercise. It is considered that 90% of the maximum intensity is the lower limit below which the exercise loses its effectiveness. This can be seen when running speed is relaxed and at the optimum level of technique.

Basketball is defined as a high-intensity sport in which anaerobic metabolism plays a key role (Hadzhiev & Dzimbova, 2020; Castagna et al., 2009).

Basketball represents about 15 to 20% aerobic exercise and 80 to 85% anaerobic exercise and many factors influence the amount of energy consumed by each player. It is impossible to determine the precise value of all styles of play. It is generally accepted that basketball is a game that requires a high level of anaerobic condition. If we watched a player throughout the match (assuming that the athlete played the whole match), we would see a work/rest ratio of 1:1 - 1:3, because the match includes periods of intense activity that are almost inseparable from the periods of inactivity such as time-outs or the break between halves. While the energy required to perform great efforts was supported in the first phase by the anaerobic system, the recovery needed to start the next exercise (or continue the match) is facilitated during rest periods by the aerobic system through the supply of ATP. (Moanță, 2000)

In basketball, successful performance depends on several fitness components (i.e., speed, agility and vertical jump height) that are anaerobic in nature (Hoffman, et al., 2000). These components must be repeated with a minimum decrease in performance during the game. Currently, there is no special test that is accepted as a standard measure of anaerobic power for basketball players.

In conclusion, we can say that, in terms of game duration, basketball is an aerobic sport although almost all its actions are anaerobic. So, in addition to the general aerobic substrate, the training must be adapted to develop more the anaerobic qualities of basketball players.

**Research purpose**

The present research aims to assess the anaerobic capacity of junior basketball players in order to obtain relevant data that will be the basis of post-lockdown training.

Anaerobic capacity, which is particularly important in the training of basketball players, is more difficult to achieve, given that anaerobic exercise is performed at an increased intensity in a relatively short time, consuming the body’s oxygen reserves. During anaerobic exercise, a high production of lactic acid is recorded, and the heart rate changes significantly but quickly returns to normal in the recovery period.
Our approach aims to identify training programmes that lead to the improvement of anaerobic capacity in young basketball players.

In accordance with the research purpose, the tasks were performed as follows:
- Explosive power assessment using the Optojump analysis and measurement system;
- Assessment of travel speed over the distances of 5 m, 10 m and 15 m;
- Calculation of indices: Flight time (s), Jump height (cm), Speed (s).

**Methodology**

**Participants**

The investigated sample included 11 participants aged 15-16 years, members of the CSU Știința Bucharest men’s basketball team (U16). They were informed about the testing procedure and agreed with the way of conducting the experiment. The research took place in January 2021, in the pre-competitive period.

**Testing procedure**

In accordance with the purpose of the research, the anaerobic capacity of junior basketball players was assessed by means of two tests that measured:
- explosive power (standing vertical jump) – Countermovement Jump (CMJ) by using the Optojump analysis and measurement system;
- travel speed over short distances: 5 m, 10 m and 15 m.

**Description of tests**

A. Countermovement jump – is used to measure explosive lower-body power, being one of the most used tests by coaches and researchers. The test can be performed with or without the help of the arms. When the arm-swing is used, the athlete’s performance can increase (Glatthorn et al., 2011) Therefore, CMJ is a suitable test for basketball players, who need a high level of explosive power.

Procedure: it is important for the test to be performed in a protected environment (gym, laboratory) with a safe and non-damp or slippery surface. If the environment is not optimal, test reliability may lead to worthless data and inefficiency.

Necessary equipment: before starting the test, we need to make sure that the Optojump computer analysis system is working properly. This is an optical measurement system that consists of a transmitting and receiving bar, each one containing 96 LEDs (1.0416 cm resolution). The LEDs on the transmitting bar communicate continuously with those on the receiving bar. The system detects any interruptions in communication between the bars and calculates their duration. This makes it possible to measure flight and contact times while performing a series of jumps with an accuracy of 1/1000 of a second. Starting from these basic data, the software makes it possible to obtain a number of parameters connected to the athlete’s performance with the maximum accuracy and in real time. (Optojump Next, 2014)
Arm-swing: the test administrator must decide before testing whether to include or eliminate the use of the arm-swing, given that it can improve performance by 10% or more (Shetty & Etnyre, 1989). If the arm-swing is not allowed, then the investigated athletes will keep their hands on their hips throughout the test; in this case, the test administrator will also pay strict attention to their hands to ensure they are not using them to press additional force through their legs. (Walker, 2016)

During flight: in this phase, it is essential for athletes to maintain extension in the hip, knee and ankle joints to prevent any additional flight time by bending their legs (Glatthorn et al., 2011; Marcovic et al., 2004).

Jump: it is important for the athlete not only to jump as high as possible but also to land in the same place where the take-off was performed, because jumping forwards, backwards or sideways can affect the test results; to prevent this, the coach can stick adhesive tape to the floor as a marker for athletes to take-off from and land on (Walker, 2016).

Each athlete in our study performed three jumps so that performance averages could be calculated. All data have been saved in the database, which makes it possible to consult them at any time but also to make comparisons between the performance of different athletes or the same athlete at different times.
B. Running speed over the distances of 5 m, 10 m and 15 m was assessed using the TAG Heuer Chronoprinter 520 (CP520) device. This photocell camera is the most reliable in sports synchronisation. Tag Heuer’s custom chip technology allows any Chronoprinter to deliver amazing performance. CP520 is useful for measuring real-time sporting events such as alpine skiing, Nordic skiing, autocross, mountain biking, road racing, kayaking, athletic racing.

Procedure: athletes ran individually with a standing start, at will. The timer of the device started when the athlete’s leg was first moved and stopped when the athlete’s chest crossed the finish line. The recorded time was labelled and statistically processed. The test was performed twice, and the best time was taken into account.

Results

According to the above methodology, the anaerobic capacity of the 11 athletes was assessed. Table 2 shows the test results, statistical data and their graphical representation.

Table 2. Test results for the investigated athletes

<table>
<thead>
<tr>
<th>Athlete no.</th>
<th>Flight time (s)</th>
<th>Height (cm)</th>
<th>5 m (s)</th>
<th>10 m (s)</th>
<th>15 m (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.49</td>
<td>29.10</td>
<td>1.05</td>
<td>2.00</td>
<td>2.77</td>
</tr>
<tr>
<td>2</td>
<td>0.48</td>
<td>28.40</td>
<td>1.30</td>
<td>1.94</td>
<td>2.90</td>
</tr>
<tr>
<td>3</td>
<td>0.54</td>
<td>36.30</td>
<td>1.08</td>
<td>1.80</td>
<td>2.31</td>
</tr>
<tr>
<td>4</td>
<td>0.52</td>
<td>33.10</td>
<td>1.19</td>
<td>1.93</td>
<td>2.69</td>
</tr>
<tr>
<td>5</td>
<td>0.52</td>
<td>33.70</td>
<td>1.30</td>
<td>1.92</td>
<td>2.90</td>
</tr>
<tr>
<td>6</td>
<td>0.56</td>
<td>37.80</td>
<td>1.01</td>
<td>1.78</td>
<td>2.48</td>
</tr>
<tr>
<td>7</td>
<td>0.58</td>
<td>41.40</td>
<td>1.28</td>
<td>1.79</td>
<td>2.42</td>
</tr>
<tr>
<td>8</td>
<td>0.54</td>
<td>35.70</td>
<td>1.10</td>
<td>1.92</td>
<td>2.77</td>
</tr>
<tr>
<td>9</td>
<td>0.49</td>
<td>29.90</td>
<td>1.14</td>
<td>1.93</td>
<td>2.65</td>
</tr>
<tr>
<td>10</td>
<td>0.43</td>
<td>32.80</td>
<td>1.13</td>
<td>1.82</td>
<td>2.54</td>
</tr>
<tr>
<td>11</td>
<td>0.56</td>
<td>37.80</td>
<td>1.30</td>
<td>1.80</td>
<td>2.74</td>
</tr>
</tbody>
</table>
Table 3. Results for the 5 m sprint test

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Standard Error</th>
<th>Median</th>
<th>Standard Deviation</th>
<th>Sample Variance</th>
<th>Minimum</th>
<th>Maximum</th>
<th>CV</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flight time (s)</td>
<td>1.170</td>
<td>0.033</td>
<td>1.135</td>
<td>0.109</td>
<td>0.012</td>
<td>1.009</td>
<td>1.301</td>
<td>9%</td>
<td>11.000</td>
</tr>
</tbody>
</table>

Table 3 shows that the mean for the 5 m sprint test is 1.170 seconds, and the coefficient of variation is 9%, which indicates that the group of athletes is homogeneous. The best time recorded is 1.009 sec, and the worst time is 1.301 sec for the 11 athletes.

Table 4. Statistical analysis of the 10 m sprint test

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Standard Error</th>
<th>Median</th>
<th>Standard Deviation</th>
<th>Sample Variance</th>
<th>Minimum</th>
<th>Maximum</th>
<th>CV</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flight time (s)</td>
<td>1.875</td>
<td>0.023</td>
<td>1.920</td>
<td>0.077</td>
<td>0.006</td>
<td>1.782</td>
<td>1.999</td>
<td>4%</td>
<td>11.000</td>
</tr>
</tbody>
</table>

Table 4 shows that the mean for the 10 m sprint test is 1.875 seconds, and the coefficient of variation is 4%, which indicates that the group of athletes is homogeneous. The best time recorded is 1.782 sec, and the worst time is 1.999 sec for the 11 athletes.

Table 5. Statistical analysis of CMJ

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Standard Error</th>
<th>Median</th>
<th>Standard Deviation</th>
<th>Sample Variance</th>
<th>Minimum</th>
<th>Maximum</th>
<th>CV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flight time (s)</td>
<td>0.519</td>
<td>0.013</td>
<td>0.524</td>
<td>0.043</td>
<td>0.002</td>
<td>0.431</td>
<td>0.581</td>
<td>8%</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>34.182</td>
<td>1.228</td>
<td>33.700</td>
<td>4.074</td>
<td>16.598</td>
<td>28.400</td>
<td>41.400</td>
<td>12%</td>
</tr>
</tbody>
</table>

Table 5 shows that the group of athletes is homogeneous, recording coefficients of variation of 8% and 12%, respectively. The highest jump is 41.400 cm and the worst flight time is 0.581. The average is 34.182 cm and 0.519 sec, respectively.

Conclusion

The restrictions imposed by the Romanian government had major consequences on the training of CSU Știința Bucharest athletes. The lockdown period during which they trained at home as well as the short training period before the start of the championship had an impact on their results.

The data obtained in this study provided useful information on the players’ potential and the limits existing in the U-16 athletes of the CSU Știința Bucharest team.

The CMJ test average of 34.182 (Table 5) is thought to be a poor result.

The results achieved in speed tests over the distances of 5 m, 10 m and 15 m show that the group of athletes involved in the study is homogeneous because the coefficients of variation are 9%, 4% and 7%, respectively, due to the centralised training in which they participated.

Assessing the training level of U-16 basketball players provides the opportunity to properly plan their physical, technical and tactical training according to each one’s skills. Considering this aspect, the results obtained by athletes in physical tests and the available
training programme, we can say that the group of participants is at the level of a beginner team, and the content of the training programme needs to be adapted to the requirements of such a team.

The group of athletes involved in our research must continue their physical training to meet the standards of an elite junior competition.

Authors’ Contribution

All authors have equally contributed to this study and should be considered as main authors.

References


