TESTS FOR THE EVALUATION OF THE SPECIFIC MOTOR SKILLS OF WHEELCHAIR BASKETBALL PLAYERS – A SYSTEMATIC REVIEW

The foundation for the improvement of the quality of each player are their basic skills, but success in wheelchair basketball is considered to mainly depend on the level of specific motor skills which represent the end result of work done during a specific training process. The paper aims to outline the used tests for the evaluation of specific motor skills of wheelchair basketball players in papers published between 2008 and 2022. To compile the existing studies the following databases were searched: PubMed, SCIndeks, PEDro, J-GATE, SCIndes, DOAJ and Google Scholar. Research published in the period from 2008 to 2022 was analyzed. The analysis of the compiled studies to evaluate the specific motor skills of wheelchair basketball players resulted in a recommendation for the use of several tests such as the: 20m sprint with ball test, Pick-up the ball test, the Lay-up test, the Pass for accuracy test, and the Free-throw shooting test. Based on the results achieved on these tests, it is possible to perform a selection and monitor the progress of the players, as well as the impact of the applied specific training process on the development of motor skills on which success in wheelchair basketball depends.

2022. godine. Analizom prikupljenih istraživanja za procenu specifičnih motoričkih sposobnosti košarkaša u kolicima preporučuje se korišćenje nekoliko testova kao što su: Test sprinta za brzinu i kontrolu lopte na 20m (20m sprint with ball test), Test brzine podizanja lopte sa poda (Pick-up the ball test), Test „polaganja“ lopte u koš za kontrolu lopte, brzinu i preciznosti šuta (Lay-up test), Test prizivnosti dodavanja (Pass for accuracy test) i Test šutiranja slobodnih bacanja (Free-throw shooting test). Na osnovu ostvarenih rezultata u ovim testovima moguće je izvršiti selekciju i praćenje napretka igrača, kao i uticaj primenjenog specifičnog trenarstva na razvoj motoričkih sposobnosti od kojih zavisi uspeh u košarci u kolicima.

Introduction

As one of the more attractive sports today adapted for persons with disabilities, wheelchair basketball represents an ideal solution for social rehabilitation and social integration (Kasum, 2015). When we analyze the basic rules of the game, we can note a considerable similarity with basketball for individuals without disability. The specific nature of wheelchair basketball as a Paralympic sport, in addition to the clear difference that the players compete sitting in wheelchairs, is also reflected in the clearly defined rules and classification of players which is used to equate team potential (Kozomara, et al., 2019). Increasing competitiveness, closely related to increased interest and the participation of young individuals with disability in wheelchair basketball, impacts the frequent analyses of certain motor tasks performed during the game itself, all with the aim of developing improved methods and training programs (Bergaminet al., 2015).

Wheelchair basketball is characterized by numerous slaloms and changes in direction, frequent sprints and wheelchair stops, as well as alternations between aerobic and anaerobic energy processes during the game itself (Bloxham, et al., 2001; Chen, Limroongreungrat, & Change, 2005; Marszałek et al., 2019a). Bearing in mind that situations during the game itself take place in a dynamic and unstable environment and that the tasks of the players can be quite complex (Cohet al., 2018), the coach should as a necessity possess adequate knowledge of the individual characteristics of each player on the court (Mason, van der Woude, & Goosey-Tolfrey, 2013). Players in this intermittent sport must perform combinations of and possess a certain level of development of several complex skills such as using and maneuvering wheelchairs and controlling the ball (Cavedon, Zancanaro, & Milanese, 2015; Marszałek et al., 2019b). Based on the available literature, mobility in a wheelchair and the interaction between players, that is the achieved level of physical performances (basic and specific motor skills) to a great extent determine success in wheelchair basketball (de Witte et al., 2016). The foundation for the improvement of the quality of each player, which is exceptionally important, are the basic motor skills, but success in sport primarily depends on the degree of development of specific motor skills which represent the end result of work during a specific training process (Stojiljković, 2003). Considering the aforementioned, and the fact that success in a certain sport is related to the features of that sport, but also of certain specific skills and the features of the athletes (Hadžović et al., 2019), the creation of a battery of tests for compiling relevant data and the evaluation of specific motor skills of wheelchair basketball players becomes an imperative.

The purpose of the subject research is to establish the tests used to assess the specific motor abilities of basketball players in wheelchairs in published works in the period from 2008 to 2022.

Methods

To compile studies which used batteries of tests to evaluate the specific motor skills of wheelchair basketball players, the following electronic databases were searched: PubMed, ScIndeks, PEDro, J-GATE, ScIndes, DOAJ, and Google Scholar. Studies published between 2008 and 2022 were analyzed. To search the databases, the following keywords were used: wheelchair basketball, motor abilities, skills, specific. The titles of the studies were identified, and then the abstracts and entire texts were read and analyzed. The analysis was carried out by the authors, while the previously published studies were analyzed in detail based on set criteria.

Inclusion criteria

For an experimental study to be included in the final analysis, it had to satisfy certain criteria:

• that the study was published between 2008 and 2022;
• that the sample of participants in the study was made up of players competing in official wheelchair basketball competitions;
• that the studies relied on field tests which were used to test specific motor skills of wheelchair basketball players whose results were presented numerically;
• that the study was written in English.

Exclusion criteria

The exclusion criteria were the following:

• studies which did not focus on specific motor skills of wheelchair basketball players;
• studies which used only laboratory tests to evaluate specific motor skills;
• duplicate studies and studies not written in English.
Research that met the set parameters was analyzed as follows: reference, sample of respondents, assessed abilities.
and tests used to assess the motor skills of wheelchair basketball players.

**Results**

By applying the given parameters, 917 researches with the requested topic were found (Figure 1.), but only 12 of them were analyzed (Ergun et al., 2008; De Groot et al., 2012; Ayán, Cancela, & Fernández, 2014; Cavedon et al., 2015; Gilet et al., 2015; Granados et al., 2015; Iturricastillo et al., 2017; Yüksel & Sevindi, 2018; Kozomara et al., 2019; Marszalek et al., 2019b).

**Table 1: A systematic overview and characteristics of the studies included in the analysis**

<table>
<thead>
<tr>
<th>Authors (year of publication)</th>
<th>Age of the participants</th>
<th>Number of the participants</th>
<th>Evaluated abilities/characteristics</th>
<th>Applied field tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ergun et al. (2008)</td>
<td>/</td>
<td>n = 32</td>
<td>Morphological characteristics</td>
<td>Lay-up test; 20m sprint test; Figure eight with ball test; Zone-shot test; Pass for accuracy test</td>
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</tbody>
</table>

![Figure 1: The analysis of the studies](image_url)
<table>
<thead>
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<th>Authors (year of publication)</th>
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<tbody>
<tr>
<td>De Groot et al. (2012)</td>
<td>18±5.2 n =19</td>
<td>Basic motor abilities</td>
<td>5 m sprint test; 20 m sprint with ball test; Free-throw shooting test; Maximal pass test; Slalom test; Lay-up test; Pick-up the ball test; Spot shot test; Suicide test</td>
<td></td>
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<tr>
<td>Ayán et al. (2014)</td>
<td>29.6±5.4 n =12</td>
<td>Specific motor abilities</td>
<td>Pass-for-accuracy test; Free-throw shooting test; Spot shut test; Lay-up test; 5 m sprint test; Multi-stage fitness test; Maximal post test; 20 m sprint with ball test; Pick-up the ball test; Slalom test</td>
<td></td>
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<tr>
<td>Cavedon et al. (2015)</td>
<td>18.1±4.06 n =52</td>
<td>Anthropometric characteristics</td>
<td>5 m sprint test; 20 m sprint with ball test; Suicide test; Maximal pass test; Pass for accuracy test; Spot shot test; Lay-up test</td>
<td></td>
</tr>
<tr>
<td>Gil et al. (2015)</td>
<td>33.30±8.01 n =13</td>
<td>Anthropometric characteristics</td>
<td>5 m sprint test; 20 m sprint test; 5 m sprint with ball test; 20 m sprint with ball test; Agility T-test; Pick-up the ball test; Maximal pass test; Medicine ball throw test; Modified 10 m Yo-Yo Intermittent Recovery Test</td>
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<tr>
<td>Granados et al. (2015)</td>
<td>33.10±7.40 n =19</td>
<td>Anthropometric characteristics</td>
<td>5 m sprint test; 20 m sprint test; 5 m sprint with ball test; 20 m sprint with ball test; Agility T-test; Pick-up the ball test; Maximal pass test; Medicine ball throw test; Handgrip test; Yo-Yo Intermittent Recovery Test</td>
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<tr>
<td>Iturricastillo et al. (2015)</td>
<td>26.5±2.9 n =8</td>
<td>Anthropometric characteristics</td>
<td>5 m sprint test; 20 m sprint test; 5 m sprint with ball test; 20 m sprint with ball test; Agility T-test; Pick-up the ball test; Maximal pass test; Medicine ball throw test; Handgrip test; Modified 10 m Yo-Yo Intermittent Recovery Test</td>
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<tr>
<td>Yanci et al. (2015)</td>
<td>33.06±7.36 n =16</td>
<td>Morphological characteristics</td>
<td>5 m sprint test; 20 m sprint test; 5 m sprint with ball test; 20 m sprint with ball test; Agility T-test; Pick-up the ball test; Maximal pass test; Modified 10 m Yo-Yo Intermittent Recovery Test</td>
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<tr>
<td>Oliveira et al. (2017)</td>
<td>22.5±5.3 n =22</td>
<td>Anthropometric characteristics</td>
<td>Test peak oxygen consumption; Wingate anaerobic test; Rectangular Agility test; 30 m sprint test; Medicine ball throw test; Handgrip test</td>
<td></td>
</tr>
<tr>
<td>Yüksel &amp; Sevindi (2018)</td>
<td>34.33±7.52 n =21</td>
<td>Anthropometric characteristics</td>
<td>Modified functional reaching test; Modified sit-up test; Modified abdominal endurance test; Modified push-up test; Plate tapping test; Handgrip test; Back Scratch test; Maximal pass test; Lay-up test; 20 m sprint test; Zone-shot test; Slalom without a ball test; Slalom with a ball test; Pass for accuracy test; 6 min. endurance race test</td>
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Discussion

An overview of the existing studies determined that the motor skills (basic and specific motor skills) is an inexhaustible topic for study, as well as a focus of interest of researchers in this domain of sport. In accordance with purpose of the current study, studies which primarily focused on specific motor skills in combination with other factors, mainly the morphological characteristics of athletes, and which relied on tests which estimate the specific motor skills of wheelchair basketball athletes, are presented (Table 1). As in basketball for players without disability, for basketball for persons with disabilities, the interaction between morphological and functional characteristics, as well as the motor skills which actually determine the position of a player on the basketball court, is significant (Drinkwater, Pyne & McKenna, 2008). An analysis of the studies also determined that in wheelchair basketball, tests which evaluate physiological characteristics are quite often used in combination with tests of motor skills (Ayán et al., 2014; Gil et al., 2015; Granados et al., 2015; Iturricastillo et al., 2015; Yanci et al., 2015; Kozomara et al., 2019) and the 20 m sprint with a ball test (De Groot et al., 2012; Ayán et al., 2014; Cavedon et al., 2015; Gil et al., 2015; Granados et al., 2015; Iturricastillo et al., 2015; Yanci et al., 2015; Kozomara et al., 2019). In addition, another test which is characteristic for wheelchair basketball and which is often used in the field by researchers to evaluate the speed and technique of maneuvering wheelchair, and picking up a ball, is the Pick-up the ball test (De Groot et al., 2012; Ayán et al., 2014; Gil et al., 2015; Granados et al., 2015; Iturricastillo et al., 2015; Yanci et al., 2015).

Coaches of various sports, and thus wheelchair basketball coaches, are constantly on the lookout for tests of specific motor skills which reflect the specific nature of the game (Goosey-Tolfrey & Leicht, 2013; Marszalek et al., 2019a), which is why tests used to control speed, precision ball control, and passing and throwing (the Lay-up test; Spot shot test; Zone-shot test) are often a topic of interest of experts in the field and are an unavoidable part of testing during the selection process. In the analyzed studies, some of the most frequently used tests, which reflect specific situations of scoring a basket during the game, include the Lay-up test (Ergun et al., 2008; De Groot et al., 2012; Ayán et al., 2014; Cavedon et al., 2015; Yüksel & Sevindi, 2018), and for the precision in passing the ball, the Pass for accuracy test (Ergun et al., 2008; Cavedon et al., 2015; Yüksel & Sevindi, 2018) To assess the power of the upper limbs, tests such as the Maximal pass test and Medicine ball pass test (De Groot et al., 2012; Ayán et al., 2014; Cavedon et al., 2015; Gil et al., 2015; Granados et al., 2015; Iturricastillo et al., 2015; Yanci et al., 2015; Yüksel & Sevindi, 2018) and the Medicine ball throw test and Medicine ball chest pass test (Gil et al., 2015; Granados et al., 2015; Iturricastillo et al., 2015; Oliveira et al., 2017; Yüksel & Sevindi, 2018; Kozomara et al., 2019; Marszalek et al., 2019b) and the Medicine ball throw test and Medicine ball chest pass test (Gil et al., 2015; Granados et al., 2015; Iturricastillo et al., 2015; Oliveira et al., 2017; Yüksel & Sevindi, 2018; Kozomara et al., 2019; Marszalek et al., 2019b) and the Medicine ball throw test and Medicine ball chest pass test (Gil et al., 2015; Granados et al., 2015; Iturricastillo et al., 2015; Oliveira et al., 2017; Yüksel & Sevindi, 2018; Kozomara et al., 2019; Marszalek et al., 2019b) and the Medicine ball throw test and Medicine ball chest pass test (Gil et al., 2015; Granados et al., 2015; Iturricastillo et al., 2015; Oliveira et al., 2017; Yüksel & Sevindi, 2018; Kozomara et al., 2019; Marszalek et al., 2019b) and the Medicine ball throw test and Medicine ball chest pass test (Gil et al., 2015; Granados et al., 2015; Iturricastillo et al., 2015; Oliveira et al., 2017; Yüksel & Sevindi, 2018; Kozomara et al., 2019; Marszalek et al., 2019b) and the Medicine ball throw test and Medicine ball chest pass test (Gil et al., 2015; Granados et al., 2015; Iturricastillo et al., 2015; Oliveira et al., 2017; Yüksel & Sevindi, 2018; Kozomara et al., 2019; Marszalek et al., 2019b) and the Medicine ball throw test and Medicine ball chest pass test (Gil et al., 2015; Granados et al., 2015; Iturricastillo et al., 2015; Oliveira et al., 2017; Yüksel & Sevindi, 2018; Kozomara et al., 2019; Marszalek et al., 2019b) and the Medicine ball throw test and Medicine ball chest pass test (Gil et al., 2015; Granados et al., 2015; Iturricastillo et al., 2015; Oliveira et al., 2017; Yüksel & Sevindi, 2018; Kozomara et al., 2019; Marszalek et al., 2019b) and the Medicine ball throw test and Medicine ball chest pass test (Gil et al., 2015; Granados et al., 2015; Iturricastillo et al., 2015; Oliveira et al., 2017; Yüksel & Sevindi, 2018; Kozomara et al., 2019; Marszalek et al., 2019b) and the Medicine ball throw test and Medicine ball chest pass test (Gil et al., 2015; Granados et al., 2015; Iturricastillo et al., 2015; Oliveira et al., 2017; Yüksel & Sevindi, 2018; Kozomara et al., 2019; Marszalek et al., 2019b).
al., 2017; Marszalek et al., 2019b) were used. Research analysis indicates that there is a correlation between seat height and the functional class of the participants, and the parameters of specific motor skills (Cavedon et al., 2015), that force of the upper limbs correlate with players classification (Gil et al., 2015), and that there is a significant influence of the muscle tissue of the upper extremities on the athletic performance of basketball players (Oliveira et al., 2017).

Researchers indicate distinction in physiological performance between different classification categories (Marszalek et al., 2019a), and recommend to trainers to compose endurance and strength exercising in order to upgrade sprinting and harmonize them with the requirements of the physiological requirements of a certain competitive level (Granados et al., 2015). In addition, the authors claim that there are no differences in terms of the anthropometrical characteristics of players of various competitive ranks at the national level (Yüksel & Sevindi, 2018) and that there were minimal differences in the amount of movement between various playing positions (back, wing, center) (de Witte et al., 2016), but they find differences in the results of the technical, tactical, and base motor skills (primarily in terms of endurance and coordination) (Erdemir et al., 2009) and specific motor skills (Cavedon et al., 2015). At the same time, existing studies indicate that experience playing wheelchair basketball correlates with agility and the displayed technique of the players (Gil et al., 2015), as well as affecting physical fitness and sports skills (Ergun et al., 2008).

Based on theoretical findings of studying wheelchair basketball, we concluded that an advantage of one team over another could be achieved in several ways, that is, the approach must be multidimensional. This indicates that the advantage of one team, or viewed individually, the advantage of one player over another, is realized through the combination and mutual permeation of various aspects of sports preparation, such as the technical, tactical, psychological, fitness aspect, etc. Beginning with the multidimensionality of the approach, the anthropological space of the players certainly also impacts the results, where we primarily analyze the characteristics and skills which are relevant for sport, such as morphological and conurate characteristics, as well as cognitive and motor skills. A multidimensional approach to a problem requires the study of all the aforementioned factors in order to obtain the complete picture, however, studies with such an approach are difficult to realize. Bearing that in mind, the research was conducted with purpose to find out answer which specific motor skills of basketball players in wheelchairs lead to differences between higher quality and lower quality players.

**Conclusion**

Finally, the analysis of the research established the existence of established tests of specific motor abilities of basketball players in wheelchairs. To evaluate the specific motor skills in wheelchair basketball, it is recommendable to use several tests such as: the 20m sprint with ball, the Pick-up the ball, the Lay-up, the Pass for accuracy, and Free-throw shooting. The aforementioned tests were used by both researchers and coaches for the purpose of selecting players and monitoring the impact of the applied specific training process on the progress of skills characteristic for wheelchair basketball and could be of considerable importance and assistance for coaches when planning and programming the training process.

**REFERENCES**


Đorđević. THE EFFECTS OF DIFFERENT EXERCISE PROGRAMS ON THE DEVELOPMENT OF TENNIS PLAYERS' AGILITY: A SYSTEMATIC REVIEW

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