Reliability of a New Multicomponent Agility Test for Assessing Agility in Basketball Players: The Basketball Multicomponent Agility Test (BMAT)

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Abstract: Background: Current agility tests assess one or multiple components of agility, including unidirectional, bidirectional, and multidirectional movements, which may or may not include retropulsion and rapid acceleration and deceleration transitions along with performing basketball-specific activities such as jumping, turning around 180º and 360º, along with picking a ball and throwing it when changing direction. Hence, there is a requirement for a test which is specific to a Basketball game and also possesses the intricate movements associated with the game in a single test.

Objectives: To develop a new sport-specific agility test for assessing agility in Basketball players and determine its reliability by establishing the interrater and interrater reliability.

Materials and methods: In this explorative study 54 male Basketball players were taken with the age group 20±3 years. Subjects having acute injuries of lower limb injuries, disabled sportsmen, peripheral nerve injuries of upper & lower extremities, history of recurrent ankle sprains/ other injuries of lower limbs were excluded. The subjects had to perform the Basketball Multicomponent Agility Test (BMAT) which is a special test that has been designed specifically for Basketball players after an intricate and thorough analysis of the game through various videos of time-motion analysis. The final test hence includes all the components occurring most commonly in the game.

Results: The Intraclass correlation coefficient (ICC) across the trials for the Interrater reliability was .997 and p= < 0.01 with 95% CI. For the Intrarater reliability, the ICC across the trials was .946 at 95% CI, with p= <0.01.

Conclusion: The BMAT is a reliable assessment tool for sport specific agility assessment in Basketball players. It can be routinely used by sports scientists, strength and conditioning practitioners, for monitoring the training programs for Basketball players.

Keywords: Agility, Agility Testing, Basketball, Multicomponent Agility Testing, Reliability.

I. INTRODUCTION

Basketball is a predominantly anaerobic sports discipline, where most of the energy demands for high-intensity activities come from the creatine phosphate system (CP). Anaerobic glycolysis with the production of lactate as a metabolic by-product is incorporated less often in game situations and occurs only when a high-intensity activity lasts for 10 to 30 sand energy has to be derived from muscle glycogen stores. [1]During a basketball game, professional players cover an overall distance of about 3500-5000 m. nearly 1000 brief activities which change approximately every 2 seconds are performed by each player. Basketball players will complete between 40-60 short sprints, over 40 jumps, and approximately 100 high-intensity basketball-specific movements that commonly involve direction changes during a game.[2]In Basketball, maximal runs often require a change of direction. Moreover, it was observed that elite Basketball player while transitioning from actions like running, jumping, shuffling, or dribbling, execute more movement changes than sub-elite players. This demonstrates the need for Basketball players to

effectively change direction and the importance of how coaches can assess this capacity. For a comprehensive assessment of high-level mobility, the establishment of a series of reliable and valid tests of agility capable of assessing three distinct patterns of movement in the uniplanar, biplanar, and multiplanar directions is required.

In view of the most commonly and widely used agility testing and training tests, Illinois agility Run (IAR), T-Test, Hexagon agility test, 505 agility test, and a recently developed test for assessing Change of direction speed (CODS) i.e. Change of Direction and Acceleration Test (CODAT), etc., are well-known. These tests have been designed to assess the agility in uniplanar biplanar and multiplanar directions but are not sport-specific. Therefore, there a need for a single special test that is sport specific and which assesses all the components associated with that specific sport. Moreover, the question which arises is whether multiple agility tests for comprehensive assessment are needed or a single test is sufficient because few differences always do exist between tests which may not have been addressed about in the literature. In other words, does measuring movement in one or two planes suffice for agility testing or must all planes be assessed to ensure proficiency of mobility in a specific sport?

Basketball Multicomponent Agility Test -BMAT is a new test designed to assess the agility in basketball players. Although there is no single, gold standard basketball specific agility test, establishing the reliability of the BMAT would provide the new test with a point of context. The BMAT may be able to stress aspects of linear acceleration and change-of-direction speed along with components like, making sharp cuts, jumping, 180° and 360° turns and retropulsion (running backward) which are mandatory in basketball. Although there is no single, gold standard basketball specific agility test, establishing the reliability of the BMAT would provide the new test with a point of context. The BMAT may be able to stress aspects of linear acceleration and change-of-direction speed along with components like, making sharp cuts, jumping, 180° and 360° turns and retropulsion (running backward) which are mandatory in basketball.

The aim of this study was to establish the reliability of the BMAT. And the objective was to investigate the interrater and interrater reliability of the BMAT through test-retest method.

II. METHODOLOGY

54 Experienced State/National level Basketball players were taken with age 20 ± 3 yr., currently active in state/national level basketball competitions, having a general basketball training history (≥3 times a week) extending over the previous 2 years, who do not have any existing medical conditions and are available for all testing occasions. The exclusion was done if the player had: discontinued the sport for more than 1 year, acute injuries of the lower limb, disabled sportsmen, and peripheral nerve injuries of upper & lower extremities, history of recurrent ankle sprains / other injuries of lower limbs. A written informed consent was taken from every participant and the materials used were measuring tape, cones, basketball, hurdles, and a stopwatch.

The Basketball academies and teams were approached and were explained about the test which was performed at the basketball court during the normal working day hours from 7:30 a.m. to 11:30 a.m. to avoid disturbances in circadian rhythm. The participants were given 10 min to prepare for the test by performing their regular warm-up followed by a 5 min cool down. Subjects were also asked to repeat the same warm-up on both testing days.

The participants were asked to perform the test thrice, with the average of the three trials being considered as the best score and selected for data analysis. A 3 minute rest period was given between each trial. According to Wathen and Roll, a relief ratio of 1:3 is suggested during anaerobic interval training [3] Participants were tested by single test session per day for two days by two raters i.e. Investigator A and Investigator B. After which, the participants were called on another day i.e. day three and the readings for the BMAT were collected by the Investigator A only for intra-rater reliability.

In BMAT (Figure 1), on the "go" command, the participants sprinted straight for 10-m., followed by picking a basketball and taking a sharp 90° cut and sprinting for 5 m, thereby had carried the picked ball along and jumped over the ten hurdles of 12 inches height each placed at 1 m distance each. After reaching the marker at the end of the tenth hurdle, the participant performed an explosive vertical jump, quickly followed by an approximately 360° turn analogous to a slam shot in basketball sport and threw the basketball diagonally to the opposite side regardless of the trajectory attained by the ball thrown.

Immediately after landing, the participant sprinted diagonally for 14.1 m and took a sharp 90° cut as soon as he reached the marker at the end of the diagonal path. He then made a 45° cut and sprinted for 2.5 m, followed by three 5-m sprints made at angles of 60° each. Following the third 5-m sprint, there was another 45° cut followed by a 2.5-m sprint to the next marker followed by a straight line on which the participant ran backward for 5-m. towards the finish line.

Table: 1

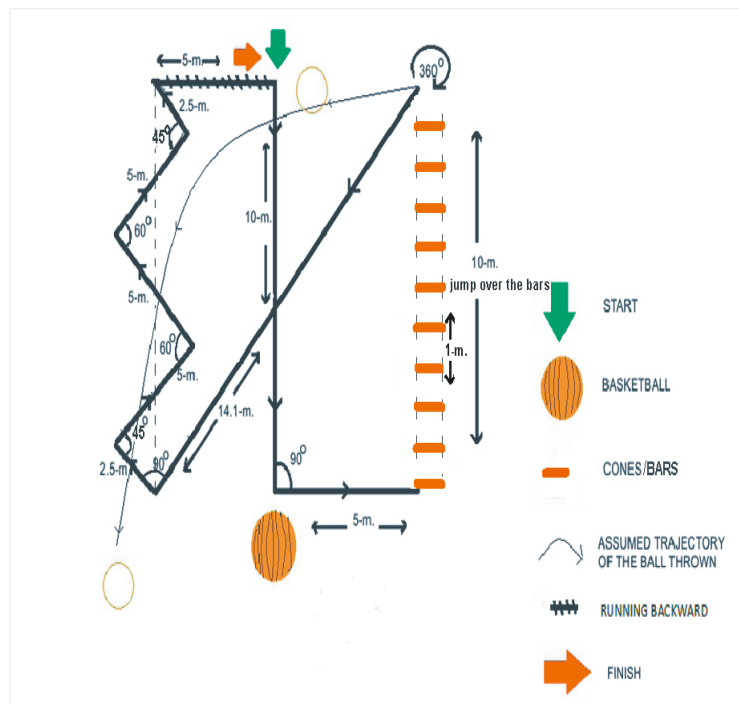| Component of measure analysis		Intraclass Correlation	95% Confidence Interval		F Test with True Value 0			
			Lower Bound	Upper Bound	Value	df1	df2	Sig
Interrater reliability	Single Measures	.997	.995	.998	641.612	53	53	<0.001
	Average Measures	.998	.997	.999	641.612	53	53	<0.001
Intrarater reliability	Single Measures	.946	.919	.966	70.813	53	159	<0.001

Figure 1: Pattern of the Basketball Multicomponent Agility Test (BMAT)

RESULTS

Data analysis was executed using SPSS version 21.0 Software. The results of the Inter-rater reliability i.e. the BMAT readings taken by Investigator A and Investigator B were as follows: ICC was .997 at 95% Confidence Interval (CI) with p=<0.001 which was highly significant (Table I). The results of the Intra-rater reliability, ICC was .946 at 98% CI with p=<0.001 which was highly significant (Table I)

Table I: Intraclass Correlation Coefficient for interrater reliability between Investigators A and B for the BMAT & Intraclass Correlation Coefficient for interrater reliability between the four trials recorded by Investigator A

DISCUSSION

The current study investigated the reliability of a new multicomponent agility test, specific for Basketball players i.e. the Basketball Multicomponent Agility Test (BMAT). The ability to repeatedly make short, maximal efforts with brief recovery periods and agility are two decisive and important fitness requirements in team games. Basketball is a sport where a repeated multidirectional 'stop-and-go' reactive agility performance is common. (Tine sattler et al).[4] According to Young et al.,2002 [5], any sprint training interventions would not only improve straight speed but also the change of direction speed, if speed had a causal relationship with a change of direction speed (CODS) and sprinting and also sprinting with directional changes were strongly related. Generally, transfers from linear acceleration are inversely proportional to the change of direction speed (CODS). i.e., the less the transfer from the straight sprint training to change direction speed, the more changes of direction. Young et al., 2002 [5] also mentioned another consideration which is relevant to the field and court sports involving complex skills, for example, running with a ball, dribbling, etc. Therefore, sprinting while performing a skill further increases the complexity of the task. This increase in complexity affects an athlete's performance, as evidenced by weak relationships between straight sprinting ability and the ability to perform complex tasks such as dribbling a basketball (Tsitskarsis et al., 2003)[6].

Based on this consideration, tests and training that address skill demands can increase validity. The literature provides several tests designed to assess these qualities separately. This study aimed to develop and evaluate a new test of agility and change of

direction skill, along with performing explosive jumps and a 3600 turn similar to a slam shot in a Basketball game. To our knowledge, this is the first study to analyze the reliability of a new multicomponent agility test specific to basketball sport.

The reliability of a fitness test is a crucial issue. It is important for establishing the reproducibility of a test and is a prerequisite to establishing the validity of the test. Reliability is usually investigated by 2 common indices: the ICC values and the 95% Limits of Agreement (LOA)/ Confidence Interval (CI) method, as they have been considered as the most appropriate for reliability assessment in previous literature. The results of this study to establish the reliability showed that the Intraclass correlation coefficient (ICC) across the trials for the interrater reliability was .997 and p= < 0.01 with 95% CI, .995 – .998 for single measures and 95% CI, .997 - .999 for average measures across the raters (Table I). Therefore, these values are indicative of a highly significant Inter-rater Reliability. Absolute Reliability (i.e. test-retest) was gathered from repeated performances of the new test the BMAT and the readings were noted by Investigator-An on two different days. Hence, for the Intrarater reliability, the ICC across the trials was .946 at 95% CI, with p= <0.01 which again indicates a highly significant Intrarater Reliability (Table I).

In line with the studies hypothesis, these results provide a measure of the BMAT's reliability in measuring multiple components of agility in Basketball players through a single test. As will be discussed, the assessment of performing multiple explosive vertical jumps; which is a measure of power, as well as the anaerobic capacity of the player, and the sport specific duration of the test, demonstrate the potentially greater value of the BMAT for Basketball-specific assessment and training of sport. Young et al,(2002)[5] previously demonstrated improvements in the performance of change-of-direction-speed tests with specific training and also showed no improvements in such performance with nonspecific training that consisted of straight-line sprinting.

This supports the purpose of this study in saying that a sport specific training would show much more improvements in the performance of the players. Nidhal Ben Abdelkrim et al [7] mentioned that Basketball sport is characterized by approximately 11% of the live time in moderate intensity running, which are likely to be performed in all directions, including running backward and even sideways. Since they accentuate the metabolic loading, such movements require greater physical demands than running forwards. Therefore, increasing the muscular efficiency of these movements through agility training would be beneficial. According to Warren B. Young et al [8] agility training may not improve straight sprinting speed, and therefore speed and agility methods should be included in a training program according to the needs of each sport. These points were taken into consideration while designing the current test and hence, also provides a logical validity to the BMAT.

The results from this study indicate that the BMAT is a reliable assessment tool for sport specific agility assessment in Basketball players. The BMAT is also reliable, when considering the ICC and also as it presented good reliability between evaluators for the criteria under consideration within the study design for the test- retest procedure. It is believed that a better result can be anticipated with certain changes and adjustments regarding the sample size, performance homogeneity of the players, and improved familiarization of the test procedures by those involved.

Also, further studies can be aimed at including players of different age, gender and ability and across greater test-retest durations to confirm these findings. Most of the COD movements in team sports are not pre-planned but executed in response to an external stimulus, such as ball movement, several interacting opponents and changing game situations (Sheppard and Young 2006)[9].The BMAT basically involves only planned agility, so measuring reactive agility performance can assure more effective training of agility in players and should also be considered in design and testing methods. Overall, the BMAT is seen to be a better measure of sport-specific capability than an equivalent nonspecific field test and that it is a reliable field based assessment that could be used for identifying quality players and athlete tracking.

Although the measurement and designing of the BMAT are a little time taking and needs skill and proficiency, it is a very useful test that can distinguish athletes of different ability levels that are practically appropriate and easy to implement and would be of great value for Basketball coaches. In modern, increasingly faster and dynamic basketball, the increase in intensity (velocity) and covered distance could largely be due to the so-called press defenses, which have become quite common. Basketball theory and practice can be substantially affected by the intensity (velocity) and distance covered by basketball players during games. The practical value of this finding is mainly seen in the planning and organization of basketball players' training, particularly during conditioning, technical-tactical and playing preparation [10]

CONCLUSION

The BMAT is found to be having a good interrater and interrater reliability and hence can be routinely used by sports scientists, strength and conditioning practitioners, and sports coaches within an assessment battery of tests for monitoring the training programs for Basketball players as it allows them to assess their players in terms of quick and proper execution of the drill and further training solutions for low-level Basketball players.

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