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RESEARCH ARTICLE

Water Polo Performance Classification Based on the Functional Test for Agility Performance: A Long-Term Training Tool

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Abstract:

Background:

Water polo is an open-skilled team sport in which agility is important.

Objective:

This study aimed to propose a water polo player classification based on the Functional Test for Agility Performance.

Methods:

A total of 78 male water polo players of different competition levels (7.7% regional, 52.5% national and 39.7% international), years of training (6.7 ± 4.5; 2-25 years), weekly training frequency (6.1 ± 2.1; 2-12) and age (18.1 ± 4.3; 12-36) were evaluated in the Functional Test for Agility Performance. Hierarchical Cluster Analysis was used in five levels to classify water polo player performance.

Results:

The players were classified based on the Functional Test for Agility Performance as excellent (≤ 3.22 s), very good (3.23-4.48 s); good (4.49-4.76 s); under development (4.77-5.11 s) and learning (≥ 5.12 s). Age, years of training, and weekly training frequency showed a decreasing trend from Gr1 to Gr4. Athletes at the international level ranked primarily in the best performing groups (Gr1 and Gr2, n = 30), the ones at the national level in the intermediate groups (Gr2, Gr3 and Gr4; n = 41), with a higher concentration in Gr2, and those at regional level mainly in Gr4 (n = 4).

Conclusion:

This classification proposal is expected to be useful as a tool to evaluate the training of athletes of different competition levels as well as to follow up on water polo athletes in long-term training.

Keywords: Water polo, Agility, Assessment, Performance, Sport, Talent, Team sport, Long-term training.

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1. INTRODUCTION

To monitor the progress of sports performance, it is common to use different types of tests and evaluations on athletes [1, 2]. However, despite their importance as a follow-up of individual [1, 3, 4] and team [5 - 7] sports performance, their frequent application may be difficult due to the administration of the test or the need for specific equipment. In addition, it should be noted that the test itself does not contain information that could be directly used in the training program. Therefore, it is essential that obtained data be evaluated, weighed, and qualified so that they, then, have a meaning [8, 9].

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One way to carry out this evaluation is by comparing athlete or team performance at different times and conditions [1, 3], or even with other athletes and teams [10]. Nevertheless, the comparison criteria are usually limited to club athletes, reducing the scope of the evaluation. In addition, even if we refer to the scientific literature, we will probably find results presented only as average performance [1, 2]. Consequently, to effectively assist coaches in the evaluation, talent selection, and training program development [11, 12], there should be proposals for classification performance within the different tests described in the literature.

It is possible to find different tests for water polo players in the literature. One study proposed isolated and combined tests to know their efficiency in discriminating athletes of two age groups (15 and 16 years old *vs*. 17 and 18 years old) [1]. The tests measured swimming speed, throwing speed, vertical jump height, and passing accuracy. Unlike the isolated tests, the main measure in the combined tests was preceded by a fatigue action. On the other hand, another study [2] assessed young water polo players (12 years old) with at least two years of training and competitions. Swimming tests (25 m, 50 m, and 100 m) and other specific tests were carried out, such as swimming four times five meters front and back crawl, leading the ball three times in a five-meter course, and throwing the ball.

Another study [11] with young players indicated that the throwing speed of water polo players between 10 and 18 years old modifies linearly with age and that vertical jump and agility showed weak but statistical correlations [13]. As in these examples, most studies show the players' average performance – sometimes accompanied by minimum and maximum performance. Thus, although the literature suggests that these data can be used as a monitoring parameter in the long-term development [1, 11, 14], there is no proposal of grouping, classification, and evolution of competition level for different performance levels.

The Functional Test for Agility Performance (FTAP) [13, 15, 16] aims to test the agility of water polo players of different levels of performance [4, 17]. In addition, it is a specific and open decision-making test in which the player being tested moves as quickly as possible within an area in response to a pass made by another player [4]. This is important because in team sports decision-making tends to be superior amongst more experienced athletes as a result of better recognition of patterns and anticipation [18, 19]. As a performance criterion, the time required to perform the test is analyzed. Depending on the test characteristics, it is considered for the evaluation of specific game conditions [4]. It is known that the FTAP is sensitive to training and can distinguish athletes of different standards of competition [15]. However, there is no study that presents a water polo player classification using player performance based on the FTAP to allow a general comparison and monitoring in long-term training.

It should be noted that high sports performance is the result of many years of planned and organized training [2, 8]. In addition, training quality is a variable that influences the excellence of training [18], and conducting tests and evaluations may contribute to it. Thus, through mathematical procedures, such as cluster analysis, it is possible to classify the athlete performance and the determinants of their performance [20]. Therefore, the goal of the present study was to propose a performance classification of water polo players based on the Functional Test for Agility Performance. We believe that, with this initiative, we might contribute to the long-term training process of young water polo players.

2. MATERIALS AND METHODS

2.1. Participants

A total of 78 male water polo players of different competition levels (7.7% regional, 52.5% national and 39.7% international), years of training (6.7 ± 4.5; 2-25 years), weekly training frequency (6.1 ± 2.1; 2-12), and age (18.1 ± 4.3; 12-36) were evaluated. The athlete classification according to the level of competition was considered the most important type of competition he had participated in at the time of the FTAP. Athletes of "regional level" were those who represented their club only in championships within the state. Athletes of "national level" were those who represented their club in national championships. Athletes of "international level" were those who represented the national team in international championships in their category. The players were instructed about the study and participated as volunteers. Each participant and their legal guardian provided written informed consent after receiving a thorough explanation of the study. The local institutional review board approved the experimental procedures.

2.2. Procedures

The FTAP was used as proposed in the literature [4, 15, 17] to evaluate the agility of water polo players. This agility is a result of a better capacity to recognize patterns, anticipation, decision-making, and quick movement [18, 19]. The test occurs in a 3-m^2 square, with five water polo players and five balls. In each corner square, there is a floating arch to keep four water polo balls in these positions. These balls are touched by the tested player during the evaluation so that he reaches the corners. The fifth ball is used to make three fast passes without deceptive movements among the four water polo players that are outside the square close to the corners. Herein, these players were randomly selected, had the same experience, and could be changed after each test. The player being tested is inside the square and should move as quickly as possible and follow the ball after the passes. Timing starts when the tested player removes his hand from the ball close to a corner and stops when two balls are removed from the arches. In the occurrence of any factor that hindered normal test performance (displacement error or wrong pass, for example), the test is repeated after one minute. The FTAP time was measured manually in seconds with a sports chronometer (Professional Stopwatch Vollo Concept – model VL233, P.B. Yang Sport, China) by an experienced coach, who was informed of the test procedures and was familiarized with the test together with the athletes.

The FTAP procedures were carried out in two days and with different water polo teams. On the first day, the players were collectively instructed on the FTAP, had the opportunity

to ask questions, and performed three to five repetitions of familiarization. On the second day, the players performed the FTAP three times, respecting a minimum interval of three minutes to guarantee recovery between the repetitions. The mean value of these three repetitions was considered as the final FTAP reference [15]. All the players performed a standardized warm-up composed of 8-minute dry-land stretching/warm-ups, followed by a 200-m freestyle swim, alternating front and back strokes using various kick styles and turns (front and back), four times 100-m crawl swim with no-push turns (in 25-m turns), and four times 25-m head-up crawl swim – starting every 50 s, alternating 12.5-m sprints and 12.5 m in recovery.

2.3. Statistical Analyses

To classify the athlete performance based on the FTAP, Hierarchical Cluster Analysis was used in five levels. This technique enables to group of the cases according to their similar characteristics. Dendrogram analysis, the nearest neighbor method, and the measure of the interval between groupings calculated by the quadratic Euclidean distance were employed. Subsequently, the athletes were classified in accordance with their performance, namely: Gr1 – Excellent; Gr2 – Very Good; Gr3 – Good; Gr4 – Under Development; and Gr5 – Learning. The crosstabs function was also used within the performance level of the players in the groups to identify the participation percentage in each group.

3. RESULTS

The characteristics of the proposed groups (Gr) by Hierarchical Cluster Analysis are presented in Table **1**. We can notice that most players were included in group two (Gr2), with 64 cases. Age, years of training, and weekly training frequency showed a decreasing trend from Gr1 to Gr4. In Gr2, athletes have trained from two and 25 years, are 13 to 36 years old, and perform two to 12 training sessions per week. In Gr3, athletes are between 16 and 18 years old, and perform four to 10 training sessions per week. Whereas, in Gr4, athletes are between 12 and 18 years old, and train between four and five sessions per week. It is still possible to demonstrate the percentage distribution of athletes by competition levels (international, national, and regional). In this case, athletes at the international level ranked primarily in the best performing groups (Gr1 and Gr2, n = 30), the ones at the national level in the intermediate groups (Gr2, Gr3 and Gr4; n = 41), with a higher concentration in Gr2, and those at regional level mainly in Gr4 (n = 4).

Based on the time performance presented in Table **1**, the FTAP classification was proposed as shown in Table **2**. Time gaps between groups shown in Table **1** were eliminated, allowing the classification of any athlete. The gap between Gr1-Gr2 (3.23-3.41 s) was added to Gr2 (3.23-4.48 s). We believe that most of the athletes with good performance will fit into this group. The gap between Gr2-Gr3 (4.49-4.58 s) and Gr3-Gr4 (4.65-4.76 s) was considered in Gr3 (4.49-4.76 s). The gap between Gr4-Gr5 (5.01-5.11 s) was considered in Gr4 (4.77-5.11 s).

4. DISCUSSION

This study aimed to propose a performance classification of water polo players based on the Functional Test for Agility Performance (FTAP). Male athletes of different competition levels and training conditions were tested, allowing the grouping and classification of the players' performance in five different levels. With this initiative, we are expected to contribute to the evaluation process in long-term training of young water polo players, and we have therefore chosen to use categorization terms that demonstrate a progression in performance rather than an inability or failure to perform test.

Table 1. Performance grouping of the water polo players tested using the Functional Test for Agility Performance (FTAP) according to number of cases, time, age, years of training, weekly training frequency, and competition level.

Gr1	Gr2	Gr3	Gr4	Gr5
Number of cases				
1	64	4	8	1
Time(s)				
3.22	3.42 - 4.48	4.59 - 4.64	4.77 - 5.00	5.12
Age (years)				
21.0	18.3 ± 4.3	17.0 ± 1.1	15.2 ± 1.9	14
Years of training				
16.0	6.9 ± 4.4	5.5 ± 2.1	3.2 ± 0.8	3.0
Weekly training frequency				
8.0	6.1 ± 2.0	7.0 ± 4.2	4.6 ± 0.5	5.0
International competition level (%)				
3.2	93.5	0	3.2	0
National competition level (%)				
0	85.4	7.3	7.3	0
Regional Competition Level (%)				
0	0	16.7	66.7	16.7

Gr = group

Table 2. Proposal of water polo performance classification based on the Functional Test for Agility Performance.

Classification	Group	Time(s)
Excellent	1	≤ 3.22
Very good	2	3.23-4.48
Good	3	4.49-4.76
Under development	4	4.77-5.11
Learning	5	≥ 5.12

Through the data shown in Table **1**, it is possible to perceive the existence of some trends to the data – which may arouse interesting discussions, yet should be used cautiously due to the players. Firstly, we highlight the variables related to the competition level, years of training and training frequency. Most players of international (93.5%) and national (85.4%) levels are in Gr2. On the other hand, most athletes of the regional level are in Gr4. In addition, players in Gr1 and Gr2 have the highest upper limit for years of training, weekly training frequency, and age. However, when we note the great heterogeneity among athletes regarding these variables, it is evident that other factors seem to influence the performance

presented in the FTAP [13]. Thus, we emphasize the importance of learning the specific game conditions [15] as a result of training.

A recent study [16] criticized the intrinsic variability of the FTAP since there are players involved in passing the ball. However, it should be noted that this is a characteristic of the real game. They [16] found statistical differences between the FTAP trials but failed to mention that the original FTAP study highlights the importance of familiarizations [17]. Moreover, recognition and recalling skills, as well as anticipating and predicting movements, are more efficiently performed by specialist athletes in genuine game tasks by better using the visual information available in their learning [19]. Hence, as indicated in the literature [19 - 21], the aspects that characterize experts are the result of the quality and years of training, not innate and general characteristics.

Athletes that are more experienced in ball sports are superior in several criteria, such as perception ability (especially in pattern recognition and anticipation), decision-making, and ability to execute movements [18, 19]. However, this experience in the sport cannot be limited to years of training [18]. Consequently, age, years of training and weekly training frequency are not necessarily indicators of performance quality. As in this study, we may have younger individuals with fewer years of training participating in international competitions within their categories [14, 19]. The development of specific performance needs is the result of years of training, still, both the quantity and quality of the stimuli received should be considered [21]. It is also possible to highlight the importance of performing tests and evaluation procedures that allow adjustments in short, medium, and long term. Hence, age should not be necessarily seen as a factor that would discriminate the athletes' performance [1, 2, 14].

The proposal of the FTAP performance classification is based exclusively on time performance. Thus, during evaluation by the coach, especially when referring to young players, other factors that influence sport performance should be considered [1, 13, 21]. Due to several factors, such as relative age and water polo experience, a young player may perform poorly because he is in the learning and training processes. But the opposite is also true if the training offered is appropriate. Therefore, depriving athletes of adequate training opportunities that would lead to performance improvement would only negatively influence the delivery of adequate performance in the future [21]. From this understanding, the proposed FTAP performance classification should not be used as a way of discriminating the opportunities offered to athletes. Moreover, one single test is not sufficient to select the best players [13].

Performance in elite sports is a result of a complex interaction between variables [13, 22] and it is important to know the factors that differentiate water polo players of various competition levels as a way of directing training [10]. Through cluster analysis, we could classify the performance of players in different groups, so that within the same group players present similar performance. But this classification should be understood as a dynamic process that can be reviewed over time [20]. As a limitation of this study, we consider that, as a result of the characteristics of the sport at world level, it would be interesting to evaluate athletes of other nationalities, women, finalists of world championships and Olympic games.

CONCLUSION

The proposed athletes' performance classification in the Functional Test for Agility Performance allowed their grouping in five different levels. It is expected that this classification proposal be useful as a tool to evaluate the training of athletes of different competition levels as well as to follow up on water polo athletes in long-term training.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The study complied with Resolution 466/12 of the National Health Council (CNS). This study was approved by the Ethics Committee under number 474.274.

HUMAN AND ANIMAL RIGHTS

The fundamental ethical and scientific requirements for research involving human beings were met, according to Resolution 466/12 of the Brazilian National Health Council.

CONSENT FOR PUBLICATION

Informed consent has been obtained prior to publication.

AVAILABILITY OF DATA AND MATERIALS

The datasets analyzed during the current study are available from the corresponding author on immediate request.

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None.

CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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