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The Beginning of Learning the Defensive Technique of Field Players and Goalkeepers in Water Polo According to Experts Opinion

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Abstract

Background: It is essential that the training of young water polo players aligns with didactic principles and the characteristics of growth and development. Despite this crucial fact, there is a lack of appropriate research. The aim of this article is to determine and explain the appropriate age to begin learning technical elements for defensive field players and goalkeepers in water polo, according to the opinions of water polo coaches. **Methods:** Twenty-seven water polo experts completed a questionnaire constructed specifically for this study. Test-retest reliability showed acceptable results (r between 0.85 and 1.00, with $p < 0.05$ for all variables). Results: Exploratory factor analysis using the Guttman-Kaiser criterion for selecting the number of factors and Varimax rotation indicated the existence of two distinct factors for the defensive technique of field players: (1) explosive and perceptive defensive activities; (2) static-repetitive defensive activities. Two distinct factors were also identified for goalkeeping technique: (1) basic goalkeeping technique; (2) advanced goalkeeping technique. Manifest space variability explained 41% and 31% of the variance for defensive technique of field players, and 45% and 44% for goalkeeping technique, respectively. **Conclusions:** The findings provide improved insight into water polo coaches' perspectives on learning simple and complex technical elements in water polo and offer crucial guidelines for all training participants.

Keywords: water polo experts; defensive technical elements; goalkeeper technical elements; early specialization

1. Introduction

Various types of movements are used in water polo. From the point of view of efficiency in the game, tactical and technical skills and the ability to reposition quickly in the game are particularly important, as they create suitable conditions for a successful play in the attack and defense phases [1], pp. 47-77. Due to variability and nonlinearity, continuous insight into the development of technical performances in young athletes is necessary. [2]. According to the opinions of water polo experts and with the help of factor analysis, four or six factors have been identified that explain the latent space of the optimal age for starting to learn the technique or tactics of water polo [3,4]. In a well-organised educational institution, didactic principles are the fundamental norms by which teaching, learning, and assessment are conducted, enabling the achievement of goals and competencies [5]. It is necessary to arrange teaching content according to didactic rules of gradation: from less difficult to more difficult, from less complex to more complex, and from known to unknown [6]. Numerous studies have addressed the effectiveness of technical performance in professional water polo players [7–11]. Young water polo players have also been included in research on technical performance [3,4,12–16]. One study on young water polo players indicates that the medium in which training takes place results in an increase in the amount of pathogens that cause inflammation [17].

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However, the health benefits of water polo training cannot be ignored [18]. Proper technical performance in water polo can certainly prevent or at least reduce injuries, which are quite common [13,19–21]. Water polo performance should be viewed holistically, as it can be improved, for example, by taking supplements [22]. By using questionnaires in water polo, we get crucial information in the design of training from both coaches [3,4,23] and young water polo players [24].

Possible problems in the methodological training of water polo players can arise from the mismatch between biological and calendar age, which was noted as early as the 1990s [25]. In practice, water polo clubs group young players by calendar age rather than biological age. In such cases, it is advisable to make exceptions and compromises when teaching certain technical-tactical elements and to adapt them to the individual, so that development paths are as appropriate as possible. Coaches of young water polo players must monitor psychophysical changes and know the methodology of the training process in order to meet the basic prerequisites for quality and continuous work. In learning water polo technique, it is essential to explain each element biomechanically and in relation to the rules of the game and specific in-game situations [1, pp. 47-77]. When the coach adds meaningful value to each technical element, the learning process becomes more holistic. In current sports practice, the most common theories of motor control that inform elite coaching pedagogy originate from psychology, with a dominant focus on internalized processes of learning and performance control [26]. In contrast, ecological dynamics is a contemporary meta-theory that offers an alternative approach, adopting an individual-environment scale of analysis to reframe explanations of skilled behavior away from internalized processes [27]. An important point for learning designers is that the perception and learning of possibilities is not an automatic internalized process, but requires periods of individualized exploration over time [28]. The variety of movements in water polo help the players to tackle the ball handling technique better and faster. Upright and stable in-water position and the balanced initial body position are usually achieved by a vigorous supporting leg movement used for the basic set-up of the technique. The player must be able to rapidly change speed and direction of movement. In addition, the water polo players must be able to coordinate all types of movements, which enables them to adopt special types of movements.

The defense technique of field players in water polo is composed of technical elements whose task is to prevent or block the attacker from passing, shooting, dribbling or receiving the ball. The defense technique of field players is divided into: (1) stealing the ball by interception; (2) face to face quick reaction towards the ball; (3) stealing the ball by sinking the hand of the attacker holding the top of the ball; (4) blocking shots; (5) defensive assistance; (6) level of defensive pressure [1], pp. 47-77.

(1) Stealing the ball by interception. This element represents the skill of the defense player to jump up and steal the ball flying with imprecise trajectory into the area between two attackers, within the reach of the defense player. While performing this element, it is extremely important to predict the flow of the ball so that the defense player can react in time. In order to take control of the ball, the player stops it with the palm and the fingers of his/her extended arm.

(2) Face to face quick reaction towards the ball. In the attempt to steal the ball in this manner, the player must predict where the ball will land or has already landed, and use a strong scissors kick to make a start towards the ball so that he/she can reach it before the attacker. After the ball has landed, the player must extend the arm and take control of the ball with an open palm.

(3) Stealing the ball by sinking the hand of the attacker holding the top of the ball. When the attacker contacts the ball, the defense player uses a sharp arm movement to sink the attacker`s arm holding the ball thus causing the attacker to violate the rules of the game. If the attacker releases the ball from the hand, the defense player lifts his/her arm to avoid a major foul for holding the player. While the attacker holds the ball above the water, the player tries to cause the attacker to drop the ball by tapping him/her on the arm, so that said player can steal the ball.

(4) Blocking shots. The skill of a player to directly mark the opponent's arm with the ball; the action is performed so that the part of the body which is to block the shot is set on the imaginary shot line in order to prevent the opponent from shooting at all, or to block the already released ball.

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Defenders usually try to cover either the immediate or the farther goal corner in accordance with the previous agreement with the goalkeeper. In the analysis of the blocking shots, we should differentiate between the individual (blocking the ball of the immediate attacker) and the team (blocking the shot from the background) aspect of the blocking shots.

(5) Defensive assistance. The ability of a player to help a defense teammate without jeopardizing his/her own defensive performance. Due to a vast variety of possible opponents` actions during the attack, the constant defensive cooperation and "overlapping of actions" in guarding the neighboring attackers is an indispensable part of the defensive performance.

(6) Level of defensive pressure. The ability to develop and maintain maximal attention and engagement in all lines of defense. Defensive pressure is primarily related to the individual tasks, roles, responsibilities, mental focus, movement speed and aggressiveness of each defender. It is manifested as: defensive pressure on the immediate ball carrier and consistent defensive pressure on attackers without the ball. Defensive pressure on the immediate ball carrier implies the ability to guard the ball carrier constantly and aggressively in one-to-one play without any defensive assistance from the teammates. Consistent defensive pressure on attackers without the ball represents the ability of defenders to aggressively guard the attackers positioned one pass away from the ball. It is manifested as: interfering with the timing and accuracy of the ball flow; hindering easy ball receptions; deflecting the passed ball in order to steal it or to interrupt the opponent's attack; closing major movement lanes (thus reducing the number of preferable attacking variants); forcing fouls on attack by intercepting the movement lane; fighting for the space and position between the ball and the attacker in the most dangerous playing area zones (the attack area up to 8 meters from the goal line).

The goalkeeping technique in water polo is divided as follows: (1) catching the ball; (2) stopping and controlling the ball; (3) ball recovery; (4) tipping out the ball or rejecting the ball; (5) lob shots saving skills. In addition to lifting the ball with one hand, according to the rules of the game, the goalkeeper, unlike the other players, is allowed to lift the ball with both hands. The goalkeeper uses the palms and the extended fingers to take the ball from underneath or above and, with the arms flexed at the elbow, lifts the ball from the water to the desired height. The selection of the goalkeeping technique depends on the speed and the trajectory of the ball flow from the attacker towards the goal, the distance and the position of the attacker with respect to the goalkeeper, and the position of the goalkeeper with respect to the central goal line.

(1) Catching the ball. The goalkeeper most frequently catches the ball with both hands and fingers slightly extended in the form of a basket. The arms are not far apart thus preventing the passing of the ball. From the basic position of the eggbeater kick and fluttering arms, the goalkeeper jumps from the water and directs his/her arms towards the expected point of contact of the hands and the ball, and recovers the ball by retracting the arms inward. The goalkeeper uses this technique for mild shots or passes from the teammates. The goalkeeper can catch the ball with one hand based on the assessment of the ball flow speed and the power of the shot.

(2) Stopping and controlling the ball. This element is usually used for the shots thrown within the half meter radius from the goalkeeper`s chin. The goalkeeper stops the ball by jumping up from the basic position and moving the body slightly frontward and sideways if the trajectory of the ball requires it. His arms are very close together and mildly flexed at the wrist with the palms facing the ball. The palms are placed towards the incoming ball so that the ball is stopped on the water in front of the goalkeeper`s chest and under his/her control.

(3) Ball recovery. If the ball is thrown towards the angles of the goal outside of the reach of the goalkeeper`s basic position, he/she makes a sudden movement to the side from the basic position and throws himself/herself towards the ball. The goalkeeper recovers the ball with the palm, forearm or upper arm and lowers it onto the water to keep it under his/her control. The goalkeeper must keep his/her fingers firmly stretched and extended to reject the ball.

(4) Tipping out the ball or rejecting the ball. If the shot is too fast and/or far from the goalkeeper`s basic position, the goalkeeper resorts to the tipping out or rejection technique. The movement

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towards the ball is identical as with the ball recovery, with the only difference that the goalkeeper cannot put the rejected ball under his/her control after the defense.

(5) Lob shots saving skills. In terms of lob shots saving skills, the goalkeeper can react in two ways. For the balls shot from close by from the center-forward position, the goalkeeper will try to reject the ball in an upward trajectory with the closer arm. If the ball is moving in a large arch and a downward trajectory, the goalkeeper initially moves backward, then uses a sudden scissors kick and upper body stretch to jump up from the basic position towards the opposite goal post, fluttering his/her arms to the side of the incoming ball. The goalkeeper`s opposite arm is completely extended in all joints towards the ball, while the upper body is twisted.

The aim of this article is to determine and explain the appropriate age to start learning technical elements for defenders and goalkeepers in water polo according to expert opinion based on positive training practice and training experience of water polo coaches.

2. Materials and Methods

Twenty-seven water polo coaching experts aged 27 to 61 from Croatia voluntarily participated in this study. The sample of variables consisted of 11 technical water polo elements divided into two relatively homogeneous groups: defensive technique of field players and goalkeeper technique.

The field players' defensive technique is made up of technical elements whose task is to prevent or block the attacker from passing, shooting, dribbling or receiving the ball.

The field players' defensive technique is divided into: (1) stealing the ball by interception; (2) face to face quick reaction towards the ball; (3) stealing the ball by sinking the hand of the attacker holding the top of the ball; (4) blocking shots; (5) defensive assistance; (6) level of defensive pressure.

The goalkeeping technique is divided as follows: (1) catching the ball; (2) stopping and controlling the ball; (3) ball recovery; (4) tipping out the ball or rejecting the ball; (5) lob shots saving skills.

The newly designed questionnaire aimed to determine the optimal age to learn the technical elements of water polo. Participants were given the task of choosing an appropriate age to start learning water polo techniques. The first choice was age 10, as this is the first year of water polo training for youth players. The last option for starting to learn certain water polo techniques was the seventh year of playing water polo, i.e. the age of sixteen.

Descriptive statistics were calculated for each item, including the arithmetic mean (M), the standard deviation (SD), the median (MED), the minimum (MIN) and the maximum (MAX). The test-retest method was used to assess the reliability of the results obtained. Correlation coefficients between the test and retest were used as a measure of reliability. An exploratory factor analysis was conducted to assess content validity and define the underlying structure, using the Guttman-Kaiser criterion to determine the number of real-world factors and varimax raw rotation. For this study, the type I error was set at 5%, and all statistical analyses were performed using Statistics for Windows version 13.0.

3. Results

High test-retest reliability was observed, ranging from 0.85 to 1.00 ($p<0.05$). Excellent internal consistency was found for the extracted factors pertaining to goalkeeping and defensive activities, with Cronbach's alpha values ranging from 0.81 to 0.95.

Table 1 presents the basic descriptive parameters for the defensive technique of field players and goalkeeping technique in water polo.

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Table 1. Results of descriptive statistics for defence technique of field players and goalkeeping technique in water polo:

Variable	M±SD	Med	Mod	Min	Max
SBI	12.56±0.85.	12.00	12.00	11.00	14.00
FQTB	12.30±0.82	12.00	12.00	11.00	14.00
SBSH	12.11±0.85	12.00	12.00	11.00	14.00
SB	12.74±0.90	13.00	13.00	11.00	14.00
DA	12.59±0.84	13.00	12.00	11.00	14.00
LDP	12.63±1.11	13.00	13.00	11.00	15.00
GKCB	11.78±0.93	12.00	12.00	10.00	14.00
GKSCB	11.81±0.88	12.00	12.00	10.00	14.00
GKBR	12.26±0.90	12.00	12.00	11.00	14.00
GKTB	12.15±0.95	12.00	12.00	10.00	14.00
GKSLS	12.37±0.88	12.00	12.00	11.00	14.00

Legend: SBI-stealing the ball by interception; FQTB-face to face quick reaction towards the ball; SBSH-stealing the ball by sinking the hand of the attacker holding the top of the ball; SB -blocking shots; DA-defensive assistance; LDP-level of defensive pressure; GKCB-catching the ball; GKSCB-stopping and controlling the ball; GKBR-ball recovery; GKTB-tipping out the ball or rejecting the ball; GKSLS-lob shots saving skills.

The results in Table 1 show that all the defensive techniques learned by field players begin in the third year of training of young water polo players (M-12.11; M-12.30; M-12.56; M-12.59; M-12.63; M-12.74). The first two goalkeeping techniques, namely catching the ball and stopping and controlling the ball, are learned in the second half of the second year of training (M-11.78; M-11.81). The remaining three goalkeeping techniques, such as recovering the ball, tipping the ball out or rejecting the ball and lob shots, begin to be learned by the young water polo players in the first half of the third year of training (M-12.26; M-12.15; M-12.37).

According to the results in Table 2, two relatively independent latent dimensions for the field players' defensive techniques were separated using factor analysis and explained as follows: (1) explosive and perceptive defensive activities; (2) static-repetitive defensive activities, which explained 41% and 31% of the variability of the manifest space, respectively.

Table 2. Factor analysis of expert's opinion of optimal beginning age for learning defence technique of field players in water polo (Expl.Var – variability explained by single factor; Prop.Totl – proportion of variability explained by single factor).

Variable	Factor 1	Factor 2
SBI	0.83	0.06
FQTB	0.85	0.05
SBSH	0.44	0.80
SB	-0.12	0.90
DA	0.62	0.57
LDP	0.67	0.28
Expl.Var	2.44	1.87
Prp.Totl	0.41	0.31

Legend: SBI-stealing the ball by interception; FQTB-face to face quick reaction towards the ball; SBSH-stealing the ball by sinking the hand of the attacker holding the top of the ball; SB -blocking shots; DA-defensive assistance; LDP-level of defensive pressure.

According to the results in Table 3, there are also two relatively independent latent dimensions for goalkeeping technique, which were explained as follows: (1) basic goalkeeping technique; (2) advanced goalkeeping technique, which explained 45% and 44% of the variability of manifest space, respectively.

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Table 3. Factor analysis of expert's opinion of optimal beginning age for learning defence technique of field players in water polo (Expl.Var – variability explained by single factor; Prop.Totl – proportion of variability explained by single factor).

Variable	Factor 1	Factor 2
GKCB	0.95	0.21
GKSCB	0.96	0.17
GKBR	0.31	0.89
GKTB	0.07	0.93
GKSLS	0.55	0.69
Expl.Var	2.23	2.20
Prp.Totl	0.45	0.44

Legend: GKCB-catching the ball; GKSCB-stopping and controlling the ball; GKBR-ball recovery; GKTB-tipping out the ball or rejecting the ball; GKSLS-lob shots saving skills.

4. Discussion

The results of this study demonstrate the reliability and validity of a newly constructed questionnaire for determining the optimal age to begin learning water polo skills. Moreover, the questionnaire organises the technical elements effectively. The results of the mean scores indicate that the coaches probably think that it is too early to start learning the defensive skills of goalkeepers and field players in water polo in the first year of training. In the second year of training, water polo coaches only start learning two basic goalkeeping techniques, while all the complex technical elements for goalkeepers and defenders are not learned until the third year of training.

The factor labelled explosive and perceptive defensive activities represents the first latent dimension for field players' defensive technique and is determined by the following four variables: stealing the ball by interception; face to face quick reaction towards the ball; defensive assistance; level of defensive pressure. The first latent dimension accounts for 41% of the variability of the items. This latent dimension is defined by the characteristics of the variables of explosive movements and perceptual activities in water polo. The first element comprises an explosive movement in the form of a vertical jump, while the second element comprises, among other things, a timely and fast approach to the ball, which is also part of an explosive movement. The other two elements are characterized above all by a high degree of understanding of the game. In addition to their explosive characteristics, all of the structural elements mentioned above are also highly complex, and it is quite understandable that they belong to the same latent dimension.

The second latent dimension of the defensive technique of field players could be described as static-repetitive defensive activities. The second latent dimension, which is responsible for 31% of the variability of the items, is determined by the following variables: stealing the ball by sinking the hand of the attacker holding the ball up and blocking shots. In the execution of the two technical elements mentioned above, the component of static-repetitive force predominates. The repetitive force is reflected in the repetitive leg movements in the egg-beater kick, while the static force is shown in holding the upper body and arms in a relatively static vertical position and in the battle of centre defender against centre forward for a better position in the game. In view of the motor similarities in the movement structure, it is quite logical that the two elements mentioned belong to the same latent dimension.

The first latent dimension of goalkeeping technique could be called basic goalkeeping technique, which is responsible for 45% of the variability of the items, as it is determined by the variables ball catching the ball and stopping and controlling the ball. This latent dimension includes simpler goalkeeping elements and can thus be explained as a fundamental latent dimension.

The second latent dimension of goalkeeping technique, which is responsible for 44% of the variability of the items, was labelled advanced goalkeeping technique. This latent dimension is

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defined by the characteristics of the variables that include more sophisticated performances such as winning the ball, tipping the ball out or rejecting the ball and the ability to save lob shots.

This study confirms that technical knowledge varies among young athletes of different ages [3,29,30]. The results, which coaches state are consistent with didactic principles, show that technical elements of water polo are learned from less to more complex elements, from known to unknown, and from less to more difficult. By distributing the technical solutions for water polo defensive technique of field players and goalkeepers according to complexity in two years, the risk of injury in young water polo players can be prevented or significantly reduced, which aligns with recommendations that early specialization in this sport is very harmful. [31]. Premature sport specialization can lead to increased psychological stress and abandonment of the sport at a young age [32]. In general, only proper periodization and methodical training can lead to the desired effects in young water polo players and other athletes. Such a clearly defined technical training plan and program is likely to further motivate young water polo players to dedicate themselves to training [33]. The limitations of this research are the relatively small number of coaches who were included in this research. A further limitation is the lack of data on coaches in terms of playing, coaching and educational level.

5. Conclusions

The results of the research show a new insight into the opinions of experts on learning simple and complex technical elements in water polo and provide essential guidelines for all participants in the training process. The findings of this study could be implemented into the training process and technical training curricula for younger age groups of water polo players. In addition, incorporating these processes would certainly significantly reduce the risk of injury, extend the lifespan of players, and promote optimal growth, development, and performance of young water polo players.

In this study, the appropriate age for learning water polo defense technique for field players and goalkeepers, divided into two areas, was determined and explained according to expert opinion. The results of the study show coaching consensus that technical skills in water polo should be taught using didactic principles. There is a high probability that results of this research can be applied in technical skills training plans and programs because it was created and explained based on established criteria and didactic principles.

Further research should include more coaches with different levels of coaching experience, playing experience and education in order to get a better and deeper insight into the acceptability and application of didactic principles in water polo.

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