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The Use of Anthropometric and Skill Data to Identify Talented Adolescent Team Handball Athletes

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Abstract

Objectives: The purpose of this study was to detect differences between selected and unselected young handball athletes following a talent selection program, and to identify those characteristics that could predict young athletes' selection in such programs. **Methods:** The sample consisted of 129 male young players all invited to train in youth pro-selection groups. Variables included height, body mass, body mass index, 30m running speed, standing long jump, hand grip strength, ball velocity, flexibility, agility with 5-0-5 test, and a shuttle run test. Statistics included a multivariate analysis of variance to investigate the mean differences on the dependent variables and a linear discriminant analysis (Wilks' lambda) for the determination of the main variables that distinguish successful sample (SP) from less successful sample (LSP) athletes. **Results:** MANOVA showed a significant effect of athletes' level, with mean values revealing the superiority of selected athletes on all variables measured. Linear discriminant analysis revealed ball throwing speed and body height as exhibiting the highest correlation that distinguish SP from LSP athletes, followed by standing jump and maximum oxygen intake variables. **Conclusions:** Statistically significant differences exist between SP and LSP athletes, in parameters that are considered basic and significant in team sports like handball.

Keywords: Skills, youth, talent, team handball

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1. Introduction

The purpose of locating and identifying talented young athletes is to provide an accurate and rational provision for those athletes who have the potential ability to successfully compete in global level. Assuming the existence of underlying factors that determine excellence in sport, talent development is based on performance prediction. Today, emphasis of trainers and scientists has been shifted from talent detection to talent guidance and development compared to the past decades of 70s and 80s focusing mostly on the detection of talented athletes through the development of sport talent-detection models. (Williams & Reilly, 2000) The selection and development process of talented young athletes become important as the modern sport international competition has become more intense involving ever younger ages. Such detection and selection involves talented young athletes of pre-adolescent and adolescent age, so as to select future athletes who have completed a period of training and acquisition of general motor skills that are prerequisites to achieve outstanding performance. (Ericsson, Krampe & Tesch-Römer, 1993)

A young athlete - talent, is possibly characterized by properties that are primarily transferred hereditary and are partially innate. (Howe, Davidson & Sloboda, 1998) The talent in a young person might not be obvious and evident at an early age, however, there are some indicators that give an idea of its existence and can become apparent through measurement procedures enabling specialists to recognize such talented potential. Motor ability, sprinting, jumping, flexibility, agility and throwing velocity represent physical activities that are considered as important aspects of the game and contribute to the high performance of the team. Successful performance requires explosive power of the legs and arms, sprint velocity and kinesthetic feeling in ball control. On the other hand, for a modern model of a handball player, the pronounced longitudinal dimensions such as stature, arm span, hand spread and length are necessary. (Skoufas et al., 2003) Such an anthropometric profile plays a supportive role in helping athletes perform under actual competitive conditions. Longer upper extremities contribute to maximizing throwing velocity and longer hand spread and length influence specific motor abilities such as dribble, passing, catching and ball throwing. (Zapartidis et al., 2009; Zapartidis et al., 2011). The purpose of this study was to detect possible differences following a talent selection program in terms of basic anthropometric characteristics and physical abilities between selected and unselected young handball athletes and to identify those characteristics that can select the young athletes participating in such programs.

1. Materials and Methods

1.1. Subjects

The total sample consisted of 138 male young handball players aged 14.1 (0.5) years from all over Greece. All players were invited to train in youth pro-selection groups. Both players and their parents were informed about the procedures of the measurements including the risks and benefits and provided their written consent for participating according to the research policy of the National University of Athens. Descriptive data for all the subjects are presented at Table 1.

Following, players were separated into a preliminary national team (successful sample SP), based on the opinions of 7 national trainers during a small overall tournament (1st phase of selection). The players, who were not selected into the preliminary national team, formed the less-successful sample (LSP). Measurement data of this study was not used in the selection process.

Anthropometric characteristics: Six variables were measured for each subject, that is, height, body mass, body mass index (BMI), arm span, hand spread and hand length. All length characteristics were measured to the nearest 0.1 cm and mass characteristics were measured in kg. BMI was computed as the ratio of body mass to the squared standing height ($Kg \cdot m^{-2}$).

Table 1. Descriptive data for all subjects

	Min	Max	Mean	SD
Body Hight (m)	1,53	1,90	1,73	0,07
Body Mass (kg)	49,00	114,70	69,87	12,91
BMI (kg*m-2)	16,80	36,40	23,19	3,66
Hand Length (cm)	17,00	21,30	19,20	0,92
Hand Spread (cm)	19,00	25,10	22,77	1,32
Arm Span (cm)	155,00	194,90	178,35	8,32
Ball Velocity (km/h)	48,00	89,00	69,04	7,66
S. Long Jump (cm)	140,00	255,00	200,94	23,70
VO2max (ml/kg/min)	35,17	66,64	50,09	5,38
Sit and Reach (cm)	10,00	50,00	31,81	7,45
30-m Speed (sec)	4,12	5,78	4,80	0,30
Agility (sec)	2,65	3,34	2,86	0,12
Hand Grip (kg)	25,00	55,00	40,39	6,10

1.2. Measurements

Physical characteristics: Seven variables were recorded for each player. These included aerobic capacity, explosive power of the lower limbs, ball velocity, flexibility, agility, running speed and hand grip strength. Aerobic capacity was expressed as estimated maximal oxygen uptake (VO_{2max}) using a 20-m shuttle run test and predicted by a regression equation according to the age and the running speed at the last completed stage. (Léger, Mercier, Gadoury & Lambert, 1988) Standing long jump was used for assessing the explosive power of the lower limbs by instructing players to stand behind a line and jump as far as possible – allowing arms and legs countermovement. Ball velocity was measured by a radar gun (Sport Electronics, USA). The height of the gun radar was adjusted individually according to the athlete's throwing arm height. The contra-lateral leg of the throwing hand was placed to the front and steadily on the ground (penalty throw).

The sit and reach test was used to the nearest 0.1cm to compute lower back and hamstring flexibility of players instructed to sit with straight legs and perform a maximal trunk flexion, aiming to reach as far forward as possible. A 90^{o} angle was kept for ankles, while value "0" was set at the position of just reaching the toes. For agility test 5-0-5, markers were set up 5 and 15 meters from a line marked on the ground. The athlete run from the 15m marker towards the line (run in distance to build up speed) and through the 5m markers, turned on the line and run back through the 5m markers. The time recorded from the moment athletes started running through the 5m markers and up to the point they returned in the same way in the starting position (10m total).

Running speed test included a 30-m sprint from a standing position. Times were recorded using electronic photocells (Brower timing system, USA). Players had to run for a distance of 30m as fast as they could. Handgrip strength of the dominant hand was measured with a hand dynamometer (Lafayette Instrument, Lafayette IN, USA). The subjects were standing with the shoulders adducted. The position of the hand remained constant in a downward direction and the palm did not flex at the wrist joint. Except 20-m shuttle run test, all other tests were performed twice from which the best was selected for analysis.

1.3. Statistics

A multivariate analysis of variance (two-group between-subjects design) was conducted to investigate the differences in mean values on the 13 dependent variables. A linear discriminant analysis using the criterion Wilks' lambda was also conducted for the determination of the main variables that distinguish SP from LSP athletes. Statistical significance was set at $p < .05$.

2. Results

2.1. Preliminary analysis

Nine extreme scores were observed and were eliminated from the analysis leaving a total of 129 subjects (87 LSP and 42 SP). Correlation analysis revealed a high positive correlation between body height and arm span ($r = .862$), body height and hand length ($r = .763$), arm span and hand length ($r = .817$), body mass and body mass index ($r = .882$). Variables of hand length, arm span and body mass index were excluded from further analysis. No statistically significant difference was noted regarding chronological age.

Box's test of equality of covariance matrices was not statistically significant (Box's $M = 63.55$, $p = .394$), indicating that the dependent variable covariance matrices are equal across the levels of the independent variable. Bartlett's test of sphericity was statistically significant approximate chi square = 4113.42, $p < .001$ indicating sufficient correlation between the dependent measures to proceed with the analysis. Evaluation of the normality determined that these date met the necessary statistical assumptions to support the analysis. Descriptive data for all variables after the preliminary analysis are presented at Table 2.

Using Wilk's criterion, the composite dependent variate was significantly affected by level. (Wilks's λ= *.731,* F= 4.35, p < .001). Mean values estimation for each variable revealed the superiority of selected athletes as regards to body height (F1,127 = 15.58, p <.001), ball throwing speed (F1,127 = 25.55, p <.001), standing long jump (F1,127 = 9.80, p = .002), maximum oxygen intake (F1,127 = 8.07, p = .005), running speed of 30 meters (F1,127 = 6.62 , p = .011), agility (F1,127 = 6.65, p = .011), and grip strength (F1,127 = 4.01, p = .047).

A simultaneous discriminant analysis was conducted to determine whether the predictors could predict handball performance.

Table 2. Descriptive data after preliminary analysis

	LESS SUCCESSFUL (N= 87)		SUCCESSFUL (N = 42)	
	Mean	SD	Mean	SD
Age (years)	14,10	0,54	14,19	0,36
Body Hight (m)	1,72	0,06	1,77*	0,06
Body Mass (kg)	68,77	11,03	69,98	12,11
Hand Spread (cm)	22,73	1,29	22,98	1,34
Ball Velocity (km/h)	67,46	6,41	73,71*	6,93
S. Long Jump (cm)	198,26	21,34	211,57*	25,08
VO2max (ml/kg/min)	49,50	4,99	52,09*	4,55
Sit and Reach (cm)	31,25	7,47	33,62	6,89
30-m Speed (sec)	4,82	0,28	4,69*	0,28
Agility (sec)	2,88	0,11	2,82*	0,12
Hand Grip (kg)	39,61	5,70	41,83*	6,31

*Significant differences between groups

The overall Wilks's lambda was significant (Λ = .731, χ^2 = 38.28, p <.001), indicating that the overall predictors differentiated between the two group internship performance groups (successful and less successful). Table 3 presents the within-groups correlations between the predictors and the discriminant function as well as the standardized weights. Based on these coefficients, the ball velocity demonstrated the strongest relationship with the discriminant function. Table 4 demonstrates how well the discriminant function was able to classify the cases for each group of the dependent variable. This discriminant function correctly classified 73.6% of all the cases. The discriminant function was slightly better at predicting the successful athletes (76.2%), than predicting the less successful (72.4%).

TABLE 3. Standardized coefficients & correlations of predictor variables

Predictors	Correlation Coefficients	Standardised Coefficients
Ball Velocity	.74	.56
Body Hight	.56	.51
S. Long Jump	.46	.06
VO_{2max}	.42	.27
Agility	-.38	.25
30-m Speed	-.38	.01
Hand Grip	.29	.39
Sit and Reach	.25	.24
Hand Spread	.14	.18
Body Mass	.08	.38

3. Discussion

The results of this study demonstrate that body high and selected skill tests, discriminate between successful and less successful talent-identified junior handball players. The discriminant analysis correctly predicted 32 of 42 successful players and 63 of 87 less successful players, that is 95 of 129 players in total. The prediction equations corresponded to an overall accuracy of 73.6% for all players, and an accuracy of 76.2% and 72.4% for the successful and less successful players respectively.

TABLE 4. Classification results

			Predicted Group Membership		Total
		Successful	No	Yes	
Original	Count	No	63	24	87
		Yes	10	32	42
	%	No	72,4	27,6	100,0
		Yes	23,8	76,2	100,0

73,6% of original grouped cases correctly classified.

These findings suggest that body size and physical fitness tests should be included in any testing of junior handball players to provide trainers with valuable information on the individual strengths and weaknesses of athletes. On the other hand, it has been reported that tactics, motivation and technical skills play a far more important role in elite-level team sports than physical and physiological characteristics. (Gabbett, Georgieff & Domrow, 2007; Mohamed et al., 2009) Moreover, the ability to perform technical and tactical skills successfully maybe is constrained by physiological limitations.

For the purpose of this study, the groups were divided according to the chronological and not the biological age. The separation of groups based on biological age was impractical. Same criteria were also used by the 7 evaluators for the original selection of the players. These athletes will also participate in the next evaluation.

Linear discriminant analysis using the criterion Wilks' lambda revealed ball throwing speed and body height as exhibiting the highest correlation that distinguish SP from LSP athletes. High physical stature affects positively all longitudinal dimensions of the body and it is considered a key element for athletes' selection that is also often connected with the result of the match. (Zapartidis, Vareltzis, Gouvali & Kororos, 2009; Zapartidis et al., 2011) This is in accordance with previous study, who considered body size as very important to achieve a high level of performance in throwing. (Reilly, 2001) Mohamed et al. (2009), examined the differences existing between elite (N =18) and non-elite (N = 29) Belgian handball players aged 15 (0.6) years old using discriminant analysis. Results showed body height and 10 x 5-m shuttle run as the most important variables that discriminate the two groups. (Mohamed et al. 2009) A basic characteristic of this study was the statistically significant higher performance of SP athletes concerning ball throwing speed that emerged as the most decisive factor discriminating the two groups. Ball throwing in competitive handball is considered as one of the most basic actions of athletes that require high ball speed and accuracy in order to be effective. (Zapartidis, Gouvali, Bayios & Boudolos, 2007; Zapartidis, Gouvali, Bayios & Hatziharistos, 2010; Zapartidis et al., 2011) Differences in ball speed have been reported at both adult men athletes and adult women athletes of different playing category.

That fact results in the distinction of the level of the athletes. (Gorostiaga, Granados, Ibáñez & Izquierdo, 2004; Granados et al., 2007) Successful players had significantly greater performance in explosive power (i.e. throwing velocity and standing long jump), and handgrip, compared to less successful highlighting the importance of well-developed strength and power qualities for elite young handball players. These findings are in accordance with Lidor et al., who reports differences between selected and non-selected boys and girls, in medicine ball throw and standing long jump in several cases during the three phases of identification. (Lidor et al., 2005) Matthys et al., also found significant differences of countermovement jump and handgrip strength when compared selected and non-selected handball players at three different ages (U14, U16 & U18), with the exception of handgrip in the U16 group. (Matthys et al., 2011) Mohamed et al., also reported significant differences between elite and non-elite 15yrs old male players in standing long jump, vertical jump height and handgrip. (Mohamed et al., 2009) Handgrip strength is an important measure of general health and is regarded as one of the most reliable clinical methods for estimation of general. (Hager-Ross & Rösblad, 2002) In team handball, the player must grip the ball pre-dominantly with one hand and for successful holding and throwing, the player needs strong hand and fingers

Compared to the less-successful group, the successful players in this study were faster and more agile confirmed previous study examining Belgian handball players. (Matthys et al., 2011) Sprinting velocity for short distances and agility, are important elements of performance in team handball.

Players are required to cover distances between 20-30 m with maximal speed from the phase of attack to the phase of defense after a ball loss, or in order to prevent a fast break and to change direction suddenly and quickly. (Zapartidis et al., 2009; Zapartidis, Vareltzis, Gouvali & Kororos, 2009) Earlier study, reported 15 years old elite players significantly better than non-elite counterparts on agility (10 x 5m shuttle run) and sprint ability (5 x 10m shuttle sprint). (Mohamed et al., 2009) Instead, other report, mention differences at 20-m speed between 12 years old selected and non-selected handball players but not at 13 years old handball players. (Lidor et al., 2005) In soccer, young elite players seems to perform significantly better than sub-elite players over 15 and 30-m sprint and were more agile than sub-elite players, additionally, agility was shown to be the most powerful discriminator between the two groups. (Reilly, Williams, Nevill & Franks, 2000)

The ability to sustain high work-rates during competition is associated with high aerobic power. (Reilly, Williams, Nevill & Franks, 2000) Maximal oxygen uptake in this study seems to be another distinguishing feature of the successful players. Depending on the level of competition and the position in the team, handball players usually cover a distances between 4.5-6.5 km and require high levels of aerobic capacity to aid recovery after high-intensity bouts of activity. (Perš et al., 2002; Zapartidis, Gouvali, Bayios & Boudolos, 2007) The player during the game should maintain the potential of the optimal output in ball velocity and accuracy in shooting and reported data refer that throwing effectiveness is significantly affected by time, as aiming accuracy gradually decreases. (Zapartidis et al., 2009; Zapartidis et al., 2010) In this stage, it is important to develop an aerobic base in younger players, as this helps to delay the onset of fatigue during training as well as during competition, contributing in simultaneous development of skills. (Zapartidis, Vareltzis, Gouvali & Kororos, 2009)

4. Conclusions

Reilly et al., showed that agility, running speed and perceptual skills were the most significant indicators of talent in soccer. (Reilly, Williams, Nevill & Franks, 2000) In volleyball demonstrated that passing and serving technique discriminate talent- identified junior players. (Gabbett, Georgieff & Domrow, 2007) Selected junior water-polo players were superior on swimming, motor ability tasks, technical tests and in game intelligence than non-selected players. (Falk, Lidor, Lander & Lang, 2004) Successful female field hockey players distinguished from less successful players in agility, running speed, game specific skills and sport psychological parameters. (Nieuwenhuis, Spamer & Van Rossum, 2002)

In team handball, speed and agility were the most discriminating factors between the two playing standards in the U14 age group, while in the older age group the strength and power, and endurance and flexibility items were the strongest discriminating factors. (Matthys et al., 2011) Previous study demonstrated that high-level adolescent handball players have both high ego and task oriented goals. (Guillet & Gauthier, 2008)

The present study examined the effectiveness of a battery of motor tests for distinguishing successful from less successful young handball players, and concluded that there is a wide overlap between successful and less successful players.

While the present results demonstrate that stature and throwing velocity are the most important factors to predicting selection in a talent-identified junior handball squad, taking into account previous studies in other sports, more features have to be examined. The selection should not be restricted to anthropometry, especially in young ages where maturation is involved. The measurement of physical characteristics in combination with specific handball game tests (e.g., aiming accuracy) and psychological test should also be included. The evolution of standard tests that simulate the game's circumstances along with the evaluation of specific physical fitness abilities and anthropometric characteristics are crucial for the future of team handball. The obvious challenge for trainers is to develop a specific skill and physical fitness test in combination with anthropometric and psychological characteristics making it possible to accurately measure the wide range of skills.

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