SELECTION OF TALENTS IN HANDBALL: ANTHROPOMETRIC AND PERFORMANCE ANALYSIS

SELEÇÃO DE TALENTOS EM HANDEBOL: ANÁLISE ANTROPOMÉTRICA E DE DESEMPENHO

SELECCIÓN DE TALENTOS EN EL BALONMANO: ANÁLISIS ANTROPOMÉTRICO Y DE RENDIMIENTO

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ABSTRACT

Introduction: Anthropometric and physical performance parameters that determine competitive levels in handball need to be carefully studied to identify which of them can bring the optimal contribution when the talents for this sport are selected. Objective: To identify which anthropometric and physical performance variables evaluated in the basic categories (infantile, under-15 and cadet, under-17) have the greatest influence on professional levels attained by male and female handball players throughout their sports careers. Method: A total of 145 handball players (75 males and 70 females) participated in the study. Participants were initially evaluated during the season 1998-99 and their performance levels were supervised until March 2013. The resulting data were classified according to the performance level (regional n = 109; national n = 36), gender, and category (infantile, cadet). Results: The MANCOVA analysis indicated that the player's maturation stage is one of the main parameters to be accounted for when selecting the variables that should configure a talent detection model for handball, which is also conditioned by sex. Anthropometric variables are highly influential in the case of male players, while physical performance variables (squat jump, counter movement jump, counter movement jump with arm, 10x5m shuttle run, 20 m shuttle run, and VO_2 max) have a similar effect in males and females. Conclusion: The study of changes occurring in anthropometric and physical performance variables may yield useful information to detect talents in handball, and maturation is a key factor to choose the most appropriate variables.

Keywords: child; body composition; muscle strength; sex; athletic performance.

RESUMO

Introdução: Os parâmetros antropométricos e de desempenho físico que determinam o nível competitivo no handebol devem ser submetidos a um estudo mais aprofundado para identificar quais deles podem contribuir de forma otimizada ao serem selecionados os talentos para esse esporte. Objetivo: Identificar quais variáveis antropométricas e de desempenho físico avaliadas nas categorias de base (infantil, sub-15 e cadete, sub-17) têm a maior influência sobre os níveis profissionais atingidos por jogadores de handebol do sexo masculino e feminino ao longo de sua carreira esportiva. Método: Um total de 145 jogadores de handebol (75 homens e 70 mulheres) participou do estudo. Os participantes foram inicialmente avaliados durante a temporada de 1998-99 e os níveis de desempenho foram supervisionados até março de 2013. Os dados resultantes foram classificados pelo nível de desempenho (regional n = 109; nacional n = 36), por sexo e por categoria (infantil, cadete). Resultados: A análise MANCOVA indicou que o estágio de maturação do jogador é um dos principais parâmetros a serem considerados ao escolher quais variáveis devem configurar o modelo de detecção de talento para o handebol, que também é condicionado por sexo. As variáveis antropométricas influenciam muito os atletas do sexo masculino, enquanto as variáveis de desempenho físico (salto agachado (squat jump), salto com contramovimento (counter movement jump), salto com contramovimento com braço (counter movement jump with arm), corrida vaivém (shuttle run) 10 x 5 m, corrida vaivém 20 m e VO_2 máx) têm efeito semelhante em ambos os sexos. Conclusão: O estudo das mudanças que ocorrem em variáveis de desempenho antropométricas e físicas podem gerar informações úteis para identificar talentos para o handebol, e a maturação é um fator chave na escolha das variáveis mais adequadas.

Descritores: *criança; composição corporal; força muscular; sexo; desempenho atlético.*

RESUMEN

Introducción: Los parámetros antropométricos y de rendimiento físico que determinan el nivel competitivo en el balonmano deben ser sometidos a un estudio más profundo con el fin de identificar cuáles de ellos pueden contribuir de forma óptima para la selección de talentos para ese deporte. Objetivo: Identificar qué variables antropométricas y de rendimiento físico evaluadas en las categorías base (infantil, sub-15 y cadete, sub-17) tienen mayor influencia sobre los niveles profesionales alcanzados por los jugadores y las jugadoras de balonmano a lo largo de su carrera deportiva. Método: Un total de 145 jugadores de balonmano (75 hombres y 70 mujeres) participaron en el estudio. Los participantes fueron evaluados inicialmente durante la temporada 1998-99 y los niveles de rendimiento fueron supervisados hasta marzo de 2013. Los datos fueron clasificados según el nivel de rendimiento (regional n = 109; nacional n = 36), el sexo y la categoría (infantil, cadete). Resultados: El análisis MANCOVA indicó que la etapa de

maduración del jugador es uno de los principales parámetros a tener en cuenta al seleccionar qué variables deben componer el modelo identificador del talento en balonmano, que también está condicionada por el sexo. Las variables antropométricas son las que mayor influencia presentan en los deportistas de sexo masculino, mientras que las variables de rendimiento físico (sentadilla con salto (squat jump), salto en contramovimiento (counter movement jump), salto en contramovimiento con brazos (counter movement jump with arm), 10 x 5 m shuttle run, 20 m shuttle run y VO_2 máx) tienen una influencia similar en ambos sexos. Conclusión: El estudio de los cambios que se producen en las variables antropométricas y de rendimiento físico puede generar informaciones útiles para la identificación de talentos en el balonmano, y la maduración es un factor clave a la hora de escoger las variables más adecuadas.

Descriptores: *niño; composición corporal; fuerza muscular; sexo; rendimiento atlético.*

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INTRODUCTION

The efforts to detect sport talent at an early age have been numerous[1-3], even though the age of performance in many sport disciplines has diminished. Most studies aimed at talent detection continue to focus on the anthropometric and physical performance parameters[1,2] with which to define new statistical analyses and incorporate variables to define different perspectives in talent prediction. This has made it possible for researchers to select and narrow down those variables with the greatest repercussion at the time of predicting performance, and to redirect the process of construction of a model of detection and selection of sportspeople[4-7].

The line of research that has proved to be more productive concentrates on outlining the characteristics of physical performance (conditional variables), as well as the anthropometric characteristics for which top levels are reached in different sport collectives[8-10]. The existing scientific literature reports that the stereotype of handball player, apart from the importance of body composition and anthropometric characteristics (height, muscle mass percentage, and biacromial diameter), should attest high values in the conditional variables, such as explosive strength capacity in the lower limbs[1,11,12]. In the case of female handball players, a clear profile has not yet been defined.

Current research works still have not reached a consensus regarding which variables within the anthropometric and conditional characteristics have a greater influence in defining young handball players' performance. Several studies[8,9,10] see these variables as important factors to detect sport talent, although others[11] consider them as bad predictors of prospective performance if the player's maturation state is not taken into account at the time of carrying out the assessment.

The present research intends to go one step further and will endeavor to determine which of the variables identified as important to reach top levels in sport (body composition, anthropometric and conditional) correspond with those which are employed at the time of selecting male and female handball players, on the basis of previous findings[2,5,9,12,13] .

This work arises from the idea of joining both proposals: top level handball player profiles as well as the role of maturation. The main objective is to identify which of the anthropometric and physical performance variables assessed in training categories (infantil, cadete) have a greater influence on the sport level reached (regional vs. national) by male and female handball players throughout their career, paying special attention to the impact maturation may have on variable selection.

METHODS

The sample was selected from a total of 522 young players in the *infantil* (12-13 years) and *cadete* (14-15 years) categories. A committee composed of five technical experts of the handball federation carried out the selection, in which none of the members of this investigation was involved. Participants were assessed during the 1998-99 season and their performance level was subsequently monitored up until March 2013 with the aim of identifying the competitive level they had achieved.

A total of 145 young handball players (75 men and 70 women) ascribed to the Galician Handball Federation (Galicia, Spain) took part in the study. All participants belonged to Galician clubs and held a current license when the research was undertaken.

The data were classified according to selection level (regional n = 109; national n = 36) and category (*infantil* n = 82; *cadete* n = 63). A male player was classified as 'national level' if they had taken part, at least during one season, in the maximum level league of the Spanish Handball Federation (ASOBAL). In the case of female players, they needed to have played in the B Honor Division. All other leagues were labeled 'regional level'.

All players undertook an anthropometric and fitness assessment in which every protocol had been approved by the Ethics Committee of the Galician Handball Federation, and parental and/or guardian consent had been provided. The Ethical Principles for Medical Research involving Human Subjects (Declaration of Helsinki) were also met.

The players performed a battery of fitness tests at the beginning of the competitive season, before their pre-season training period, and as a part of their respective training programs. The Department of Sport Science (University of A Coruña) carried out all of the assessments. Standard anthropometry, maturation and physical performance data were compiled from each participant during the regional camp.

Anthropometric measurements were made following standardized procedures by an ISAK (International Society for the Advancement of Kinanthropometry) certified anthropometrist[14]. Dimensions included arm span, height trochanter, sum of skinfolds (triceps, subscapular, supraspinal and abdominal), and two girths (thigh and leg). The sum of four skinfolds was used as the main adiposity index. The body mass index (BMI) was calculated as weight (kg) divided by height squared (m^2). Skinfolds were measured with a Harpenden Caliper, with a constant pressure of 10 g/mm^2. Skinfolds were measured using a Lufkin Metal Tape (Lufkin Executive Thinline, W606PM, USA). The arm span and height trochanter were measured using an anthropometer (GPM, Siber Hegner Zurich, Switzerland) with an accuracy of 0.01 cm. The players' maturity status was calculated using Mirwald and colleagues' equation[15]. This technique is a non-invasive method of predicting years from peak height velocity (PHV) as an indicator of maturity offset using anthropometric variables[16].

The EUROFIT test battery[17] was used to assess physical performance: aerobic endurance, general balance, segment velocity of the upper limbs, flexibility of the trunk and lower limbs, explosive strength of the lower limbs, grip, trunk power, muscular resistance of the arms and shoulders, agility and speed. Each player also performed additional tests to calculate explosive strength. Each participant performed 3 kinds of maximal jumps (squat jump [SJ], counter movement jump [CMJ] and counter movement jump with arm [AJ]) on a jump mat (Ergo Jump Bosco System Byomedics,

SCP, Barcelona, Spain). Participants completed 3 trials of each type of jump and the best one was used for the subsequent statistical analysis. Between jumps, participants were allowed to recover for 3 minutes to avoid fatigue. Jump height was calculated using flight time. The SJ showed an ICC of 0.94 and a CV of 24.2%; the CMJ showed an ICC of 0.97 and a CV of 22.1% and a CV of 22.6%. Aerobic capacity was expressed as the estimated maximal oxygen uptake (VO_2 max) using a 20 m shuttle run test and was predicted by a regression equation according to the age and the running speed of the last completed stage[18]. A 15-minute warm-up was performed before physical testing.

Mean and standard deviation (SD) scores were calculated for all dependent variables with selection level acting as the independent variable. None of the data violated the normality assumption (Kolmogorov-Smirnov; $p > 0.05$) necessary to conduct parametric statistical tests. An inferential analysis of performance level was carried out (regional vs. national) using Student's *t* for independent data, later stratifying the analysis according to gender and category (infantil, cadete). A multivariate analysis of covariance test (MANCOVA) was applied using selection level (regional vs. national) as the fixed factor. Maturity (years from PHV) was used as covariate to adjust for variations in maturation status. Partial eta squared effect sizes (η^2) were also calculated. SPSS version 15.0 was used for this analysis with significance set as $p < 0.05$.

RESULTS

The means and standard deviations of anthropometric characteristics and physical performance by category (infantil and cadete) and selection level (regional and national) are presented on Table 1. Results show that the sport level reached by male players ascribed to the *infantil* category are conditioned by their maturity status (PHV), arm span, height trochanter, sum of skinfolds, CMJ, AJ and handgrip strength. In the case of female players, the variables that proved to have an influence on sport level were the sum of skinfolds, thigh and leg girths, CMJ and AJ.

With regard to the other category under analysis (cadete), it should be observed that those the variables that significantly conditioned sport level in male players were the sum of skinfolds and flexed arm hang; while in the case of female players maturity status (PHV), height trochanter, sum of skinfolds, thigh and leg girth, CMJ, flexed arm hang, 20 m shuttle run and VO_2 max were influential.

Sum of skinfolds was the only variable that became manifest as a differential performance parameter for both categories and genders. The analysis that was carried out with female handball players reflected that four variables (sum of skinfolds, thigh girth, leg girth and CMJ) had a significant effect on performance in both categories, which was not the case in male handball players.

The anthropometric characteristics and physical performance parameters through mean and standard deviation, taking the selection level into account (i.e., regional and national), are shown in Table 2. The results indicate that maturation age influenced the players' performance level independently of gender. MANCOVA analyses between selection levels for all male players revealed that national players significantly outperformed regional players in terms of BMI, arm span, height trochanter, sum of skinfolds, thigh and leg girths, vertical jump (SJ, CMJ and AJ), standing broad jump, flamingo balance, plate tapping, sit and reach, sit-ups, 10 x 5 m shuttle run, 20 m shuttle run and VO_2 max. In the case of female players, the same phenomenon was attested for the sum of skinfolds, thigh and leg girths, vertical jump (SJ, CMJ and AJ), 10 x 5 m shuttle run, 20 m shuttle run and VO_2 max.

Table 1. Mean and standard deviation of the anthropometric and conditional characteristics of male and female handball players by category and performance level.

		Men (n = 75)				Women (n = 70)			
		Infantil (12-14 years) n = 38		Cadete (14-16 years) n = 37		Infantil (12-14 years) n = 44		Cadete (14-16 years) n = 26	
		Regional n = 30	National n = 8	Regional n = 32	National n = 5	Regional n = 30	National n = 14	Regional n = 17	National n = 9
Age (years)		13.5±0.5	14.0±0.6	15.7±0.7	15.9±0.8	13.2±0.6	12.9±0.7	15.1±0.7	14.9±0.8
Age at PHV (years)		13.4±0.7	13.7±0.7*	14.5±0.6	14.6±0.8	11.7±0.4	11.8±0.5	12.6±0.6	12.9±1.6*
Years from PHV (years)		0.4±0.7	0.4±0.1	0.6±0.7	0.8±1.1	0.87±0.5	0.6±0.8	1.9±0.4	1.3±1.1
Anthropometry									
BMI (kg/m^2)		21.3±2.8	21.9±2.8	21.9±2.9	21.2±6.6	21.8±2.6	20.5±4.1	22.7±3.7	21.1±2.3
Arm span (cm)		174.7±10.3	175.4±18.2*	181.5±9.1	183.7±7.5	164.7±7.4	166.5±9.2	166.1±3.8	168.2±9.1
Height trochanter (cm)		90.2±4.9	89.9±5.8*	93.2±4.5	93.3±2.9	82,2.6±6.3	80.9±7.2	82.6±5.9	87.2±18.1*
Sum of skinfolds (mm)		45.1±24.3	40.1±21.1*	44.1±18.8	37.4±14.0*	53.6±16.5	42.1±17.2*	66.1±30.3	46.4±12.9*
Thigh girth (cm)		17.6±6,0	18.2±6.4	15.0±2.3	17.8±5.0	21.9±8.1	25.5±6.8*	22.8±3.8	27.1±8.0*
Leg girth (cm)		14.2±7.7	15.0±7.0	14.4±6.0	18.9±1.9	14.7±6.9	17.7±6.6*	14.1±1.2	19.3±8.1*
Physical performance measures									
Squat Jump (cm)		22.5±4.2	23.3±6.3	24.8±6.8	25.7±1.2	19.1±8.0	21.8±4.2	20.6±.9	21.3±3.3
Counter Movement Jump (cm)		26.6±5.1	29.8±5.1*	30.7±5.5	31.3±2.0	20.7±8.4	24.8±4.2*	23.9±3.4	26.1±3.7*
Counter Movement Jump with arm (cm)		34.6±5.7	31.4±6.1*	37.2±7.0	39.7±4.3	24.5±10.0	29.1±4.6*	26.9±3.6	30.9±3.9
Eurofit Test	Flamingo balance (rep)	15.1±4.9	16.4±6.0	13.2±5.4	15.9±5.4	13.5±6.1	14.7±4.1	12.7±6.9	13.7±3.5
	Plate tapping (s)	122.3±11.1	119.3±9.8	116.2±11.6	108.4±9.8	119.3±10.7	115.0±10.4	114.7±9.8	105.3±11.9
	Sit and reach (cm)	16.4±7.5	19.1±3.5	21.1±6.3	22.0±6.3	23.8±6.6	19.3±5.4	26.4±6.2	18.0±12.2
	Standing broad jump (cm)	177.0±17.8	186.2±21.9	194.4±16.5	195.8±16.5	149.7±32.2	132.0±52.5	160.1±39.3	156.7±10.4
	Handgrip strength (kg)	32.3±9.4	38.2±7.7*	42.8±7.7	44.9±13.2	28.2±5.9	27.9±7.2	30.4±4.4	29.5±6.1
	Sit-ups (rep)	24.9±3.7	25.2±2.7	25.6±3.5	26.0±3.5	22.6±3.1	23.0±3.2	23.8±3.2	21.3±1.5
	Flexed arm hang (s)	302.5±156.3	312.0±195.5	308.8±39.4	335.8±39.4**	94.1±83.6	104.7±75.0	127.0±84.8	222.7±57.0**
	10 x 5 m shuttle run (s)	196.9±10.2	195.0±10.1	190.4±11.9	190.1±11.9	229.9±19.7	230.8±17.6	221.3±11.2	229.7±16.5
	20 m shuttle run (rep)	8.0±1.6	9.3±1.2	9.3±1.2	9.9±0.9	6.1±1.3	6.1±1.5	6.5±1.3	8.2±1.3*
	VO_2 max (ml·kg^{-1}·min^{-1})	50.2±4.2	51.6±3.8	51.6±3.2	53.2±3.2	46.6±3.7	47.0±4.5	44.9±3.6	49.5±2.1*

APHV: age at peak height velocity; *0.005; **0.001.

Table 2. Selection level (national vs. regional) characteristics of male and female handball players.

		Men (n = 75)					Women (n = 70)				
				Covariate					Covariate		
		Regional (n = 62)	National (n = 13)	Years PHV	MANCOVA	η^2	Regional (n = 47)	National (n = 23)	Years PHV	MANCOVA	η^2
Age (years)		15.2±0.8	14.8±1.1	-	-	-	13.9±1.1	13.4±1.2	-	-	-
Age at PHV (years)		14.4±0.6	14.8±0.5*	-	-	-	12.0±0.6	12.4±1.5*	-	-	-
Years from PHV (years)		0.2±0.8	-0.4±0.9	-	-	-	1.2±0.8	0.7±1.1	-	-	-
Anthropometry											
BMI (kg/m^2)		21.9±2.9	20.9±2.6	0.001	0.001	0.178	22.0±3.1	20.4±3.9	0.001	0.103	
Arm span (cm)		173.1±12.8	179.3±9.6	0.001	0.014	0.040	164.8±6.7	167.5±10.2	0.001	0.209	
Height trochanter (cm)		89.7±5.5	92.1±4.7	0.363	0.002	0.123	81.8±6.1	86.8±16.3	0.434	0.169	
Sum of skinfolds (mm)		42.2±18.3	38.1±25.8	0.541	0.001	0.104	55.2±22.4	43.7±18.1	0.004	0.001	0.202
Thigh girth (cm)		16.6±4.9	18.0±5.6	0.001	0.001	0.145	22.1±7.1	26.1±7.3	0.001	0.024	0.094
Leg girth (cm)		12.5±6.3	14.7±6.4	0.008	0.001	0.117	14.5±5.9	18.4±7.2	0.004	0.034	0.192
Physical performance											
Squat Jump (cm)		23.7±3.7	24.1±6.5	0.034	0.011	0.079	19.5±6.9	21.6±3.8	0.049	0.004	0.113
Counter Movement Jump (cm)		28.4±4.7	30.3±5.3	0.043	0.007	0.203	21.5±7.5	25.3±4.1	0.092	0.003	0.134
Counter Movement Jump with arm (cm)		34.6±6.7	35.9±6.5	0.038	0.011	0.345	25.1±8.8	29.8±4.4	0.046	0.001	0.142
Eurofit Test	Flamingo balance (rep)	14.4±5.0	16.1±6.7	0.756	0.016	0.213	13.2±6.4	14.5±3.8	0.134	0.065	
	Plate tapping (s)	119.9±11.3	113.7±11.9	0.027	0.015	0.101	117.5±10.5	112.6±11.1	0.322	0.802	
	Sit and reach (cm)	18.8±7.2	20.2±4.7	0.022	0.011	0.069	19.0±6.9	24.9±6.5	0.010	0.414	
	Standing broad jump (cm)	183.7±18.8	191.2±22.9	0.036	0.001	0.156	138.2±46.3	153.9±35.2	0.084	0.934	
	Handgrip strength (kg)	37.1±12.2	40.6±7.4	0.002	0.356		28.3±6.7	29.1±5.4	0.007	0.611	
	Sit-ups (rep)	24.9±3.2	25.3±3.5	0.444	0.001	0.201	22.5±2.9	23.1±3.1	0.089	0.870	
	Flexed arm hang (s)	297.7±123.0	319.3±202.6	0.435	0.341		107.1±84.9	134.2±86.8	0.456	0.099	
	10 x 5 m shuttle run (s)	194.4±10.9	192.6±9.6	0.007	0.001	0.653	230.5±16.5	226.5±17.3	0.107	0.011	0.163
	20 m shuttle run (s)	8.9±1.5	8.7±1.7	0.043	0.001	0.134	9.7±1.6	9.3±1.3	0.037	0.040	0.059
	VO_2 max (ml·kg^{-1}·min^{-1})	51.2±4.2	51.3±4.0	0.045	0.001	0.145	45.9±3.7	47.7±4.0	0.035	0.035	0.046

DISCUSSION

The analysis that was carried out within each of the categories (infantil, cadete) and gender groups revealed that maturation is not a differential performance parameter in the case of *cadete*-male and *infantil*-female, which is why a pattern of behavior may not be generalized. As regards the results obtained for the *infantil* category, significant differences were found between national and regional players in anthropometric parameters, explosive strength in the lower limbs, and forearm isometric strength (handgrip). These data are in line with the conclusions presented by Vaeyens et al.[19] and Till et al.[10], where underlying maturation stage divergences may be behind this apparent dissonance. The absence of differences in performance regarding *cadete*-male may be due to the homogeneity of the sample in terms of maturation age, given that all participants in the study underwent a careful selection by a panel of expert judges.

In the case of female players, maturation could only be considered as a conditional variable of performance within the *cadete* category. If both categories are jointly analyzed, it may be observed that top-level (national) female players present better and significant results in the following parameters: sum of skinfolds, thigh girth, leg girth and CMJ. These data reflect the importance of muscular mass and explosive strength levels, which is in line with previous studies[20-22].

Regardless of gender and category, the results obtained reveal the importance of the sum of skinfolds as an indicator of performance in male and female handball players. This parameter shows an inverse relationship with explosive strength[18].

Authors like Lidor et al.[23] and Gorostiaga et al.[20] suggest that velocity and vertical jump in handball players make it possible to discriminate between competition levels, which has been confirmed for both genders in the present study and reinforces the ideas of Ingebrigtsen et al.[12], who consider it fundamental to include general strength training in elite youth teams to develop muscular mass.

When the effect of maturation is controlled (covariate) the data also reveal that out of the 19 analyzed variables, this parameter has an influence on 14 in the case of male players and 11 in the case of female players; BMI, arm span, thigh girth, leg girth, SJ, AJ, sit and reach, handgrip strength, 20 m shuttle run and VO_2 max are common to both genders. This indicates that it is necessary to take maturation levels into account at the time of carrying out a process of identification, monitoring and selection of male and female handball players ascribed to the *infantil* and *cadete* categories. If this step were omitted, anthropometric and physical performance parameters could be misinterpreted, which, in turn, might have repercussions on the sportsperson's career. With regard to the role of maturation in talent selection, the results of the present study support previous research efforts[18-20].

Additionally, a total of 4 variables that have an influence on performance but are not altered by the process of maturation were identified for male players: height trochanter, sum of skinfolds, flamingo balance and sit-ups. Similarly, CMJ and 10 x 5 m shuttle run showed the same behavior in female players. The data suggest that, for female players, those variables that have an influence on performance but are not conditioned by maturation relate to explosive strength, which serves as a confirmation of the conclusions presented in previous studies[21,24,25].

CONCLUSION

To evaluate anthropometric and conditional characteristics in training categories within a talent selection context, they should be analyzed taking male and female players' state of maturation into account at the time of carrying out the assessment.

Certain variables, such as muscle mass and explosive strength, distinguish male and female handball players who have reached top levels (national) from those who have played in the regional leagues.

With respect to top-level female players, explosive strength has been revealed as one of the characteristics that positively discriminates talents, regardless of maturation level.

Practical implications

Coaches should take the maturity variable into consideration (and not only chronological age) when the assessment of performance is going to be carried out with their players.

It would be necessary to introduce general strength work at an early age, particularly in the case of female handball players, to develop further and faster the actions that the sport demands (dodging, throwing, jumping, creating defensive triangles, blocking, etc.).

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