Age-related differences in physical and physiological characteristics in male handball players

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Summary

Aim: Although there are studies on physical and physiological characteristics of handball player, few that process different ages in the same study. The objectives of this study were to examine the variation in physical and physiological characteristics in male handball players according to their age.
Methods: Adolescent and adult players (n = 96) were examined for anthropometric characteristics, somatotype and body composition, and performed the physical working capacity in heart rate 170 min^{-1} test, a force-velocity test, the Wingate anaerobic test (WAnT), sit-and-reach test (SAR), handgrip strength test (HST), squat jump, countermovement vertical jump without (CMJ) and with arm-swing (CMJarm), and a 30-s Bosco test.
Results: An improvement is observed with aging, to most important parameters for the handball player, such as improvement in anthropometric and somatotype characteristics, jumping ability (CMJ, CMJ with arm and SJ) and increased power.
Conclusion: It is concluded that there are differences between age groups, which between them include anthropometric characteristics (eg taller players more mesomorphic and less FFM), greater jumping ability in different variants is around 22-24% for adulthood; while power makes around 30%. It increased over time flexibility stands; and a sub-maximal heart rate more efficient along age. These studies contribute to a better understanding by the coaches of the evolution of the physical and physiological characteristics in a specialty such as handball.

Key words:
Growth and development. Sport. Physical fitness. Age groups.

Diferencias relacionadas con la edad en las características físicas y fisiológicas en jugadores de balonmano masculino

Resumen

Objetivo: A pesar de existir estudios sobre características físicas y fisiológicas del jugador de balonmano, son escasos los que tratan diferentes edades en un mismo estudio. El propósito de este artículo fue examinar la variación en las características físicas y fisiológicas en jugadores de balonmano acorde a su edad.
Método: Se seleccionaron un total de 96 jugadores de balonmano jóvenes y adultos, a los que se les realizó una evaluación de las características antropométricas, somatotipo y composición corporal, capacidad de trabajo en el test 170 $lat{\bullet}min^{-1}$, test de fuerza-velocidad, test Wingate, test *sit and reach*, fuerza de prensión manual, salto con contramovimiento (con y sin brazos), *squat jump* y test de bosco 30 s.
Resultados: Los resultados indican diferencias estadísticamente significativas en prácticamente todas las variables analizadas. Se observa una mejora según avanza la edad, hacia parámetros más importantes para el jugador de balonmano, como son mejora en características antropométricas y somatotipo, capacidad de salto en su diferentes versiones e incremento de la potencia.
Conclusiones: Se concluye que existen diferencias entre los grupos de edad, donde entre las mismas destacan características antropométricas (jugadores con mayor talla, mayor componente mesomórfico y menos MLG), mayor capacidad de salto en sus diferentes variantes que se muestran en torno al 22-24% para la edad adulta; mientras que la potencia lo hace entorno al 30%. Se destaca el incremento a lo largo del tiempo de la flexibilidad; así como una frecuencia cardiaca sub-máxima mas eficiente a lo largo de la edad. Estos datos pueden contribuir al mejor conocimiento por parte de los entrenadores de la evolución de las características físicas y fisiológicas en una especialidad como el balonmano.

Palabras clave:
Crecimiento y desarrollo. Deporte. Condición física. Grupos de edad.

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Introduction

Handball is an Olympic contact team sport with intermittent movements such as jumping, sprinting, throwing, blocking, etc. interspersed with continuous activities such as walking and running in response to different attacking and defensive situations[1-5].

Understanding the anthropometric profile or physical characteristics may be a useful means of identifying talent, facilitating the assigning of playing positions and helping find the optimum design of strength and conditioning training programmes[6,7].

It is important to establish the body composition of athletes because components such as bone, muscle and fat mass are related to performance. Studies show an increase in the height and body mass index with age. The handball players younger than 16 years, are 1.68 - 1.75 m tall and weigh between 22-23 kg•m^2 [2,8]. Adult players are around 1.81 to 1.92 m tall and weigh 24 to 25 kg•m^2 [3,7,9,10]. Ibnziaten *et al.* [11] analysed the anthropometric characteristics of 10 to 14-year olds, and Zapartidis *et al.*[12] those of 12 to 15-year olds, but these are isolated studies, in which it would be necessary to appreciate these differences in comparison to adult players, whilst also including interesting variables for handball, such as, for example, the fat mass, fat-free mass, somatotype, etc. as these anthropometric factors and morphological features may have an impact on the effectiveness of the play.

Furthermore, handball is a very complex sport and success depends on a series of abilities such as specific strength, power, speed and resistance. Creativity in play, in combination with speed, strength and coordination, make this a very attractive yet difficult game to master. The appearance of these characteristics and their interaction have led to a large number of scientists from around the world undertaking research in this field[10]. Performance in various motor tasks improves throughout childhood and adolescence, and this seems to be an important predictor of future performance. It is known that during adolescence, male players improve considerably[13]. Basic motor skills can be considered to be a complete assessment of the majority of the bodily functions in daily physical activity. Indirectly, the studies may reveal the differences between the age groups. It would appear that adults have more strength and speed compared to adolescent handball players[2,7,12], but again, these are isolated studies that do not use the same research methodology and the players are not of the same nationality.

Therefore, it is still important to delve deeper into the effect of age on the physical and physiological characteristics of handball players. The aim of this study was to examine the variation of the physical and physiological characteristics in accordance with three age groups (<15 years, <18 years and adults).

Material and method

96 male handball players were selected and divided up into 3 age groups: < 15 years group (n=32): with 2.0 ± 0.9 years of handball training experience and a weekly training volume of 4.0 ± 0.8hrs; <18 years group (n=26): with 4.0 ± 1.7 years of handball training experience and a weekly training volume of 5.9 ± 1.8hrs; adult group (n=38): with 14.4 ± 6.1 years and a weekly training volume of 8.4 ± 2.0 hrs. In total, to achieve a general representation of the handball player, we selected 17 goalkeepers, 34 central players, 30 wing players and 15 pivots. All the players belonged to the Greek National Premier League, each in their corresponding category.

The assessments were performed during the competitive season. The protocols were performed in accordance with the Helsinki Declaration and were approved by the local institute where the study was undertaken. All the players volunteered to participate in this study, signing an informed consent form, which was completed by their legal guardians in the case of subjects under the age of 18. This all occurred after they were explained the objectives, procedures and characteristics of the study. The exclusion criteria were: having an antecedent of any kind of chronic injury and the long-term consumption of medication.

The tests performed are described below:

Anthropometric assessment: Measurements were taken of the height, body mass, skin folds, body mass index (BMI), which is calculated as the ratio between the body mass (kg) and squared height (m^2). Body fat is measured based on the sum of 10 skin folds[14]. An electronic scale (HD-351,Tanita, Illinois, USA) was used to measure the body mass (precision 0.1kg), a stand-alone stadiometer (SECA, Leicester, United Kingdom) for the height measurement (0.001m) and a skinfold calliper (Harpenden, West Sussex, United Kingdom) for the skinfolds (0.5mm).

A two-component model was used for the body composition, which divides the body into fat mass, calculated as the product of the body mass by the percentage of body fat, and the fat-free mass, calculated as the difference between the body mass and the fat mass. At the same time, the Heath-Carter anthropometric method was used to establish the somatotype, which was expressed in three components: endomorph, mesomorph and ectomorph[15].

Sit and Reach Test: The players sat on the floor with their knees flat and their feet hip distance apart, with their ankles flexed at 90º. The soles of their feet were positioned perpendicular to the ground against the measuring box, and the tips of their toes were pointing upwards. In this position they were asked to bend their trunk forward as far as possible, keeping their knees and arms straight. The palms of their hands, one next to the other, slid along the box to reach the furthest distance possible. The subjects had two attempts, noting the greatest distance of the two in centimetres[16].

Physical work capacity (PWC170): This test was performed in accordance with the protocol established by the Eurofit[17] test battery on a cycle-ergometer (828 Ergomedic, Monark, Sweden). The height of the seat was adjusted to the subject, who sat with his/her feet on the pedals with straps to prevent the feet from slipping. The participants were instructed to pedal at a rate of 80 revolutions per minute, using a visual reference as a guidance on the cycle-ergometer screen. The PWC 170 test consists of three stages, each lasting 3 mins, against the strength of a gradual brake with the aim of obtaining a heart rate of between 120 and 170 beats per minute. The result is based on the linear relationship between the heart rate and power or the work load, expressed as W•kg^{-1}.

Counter Movement Vertical Jump (CMJ), Squat Jump (SJ) and Abalakov: The subjects had two attempts at each of the jumps, with the best result noted[18]. The height of the jump was measured using the

Opto-jump strength platform (Microgate Engineering, Bolzano, Italy), given in cm.

Modified Bosco 30s Test: The same equipment was used as for the CMJ test. The participants were instructed to jump as high as possible, with their feet touching the floor for as short a time as possible[19]. The average power during the 30s test was noted as $W.kg^{-1}$.

Manual pressure strength: The subjects stood upright with their legs slightly apart and their hands extended vertically down alongside their trunk, yet not touching it. In this position the subject had to press on the dynamometer handle (Takei, Tokyo, Japan) as hard as possible for 5s[17]. Two attempts were made and the result was considered to be the sum of the best on each hand, divided by the body mass and expressed as $kg{\bullet}kg^{-1}$ of the body mass.

Strength-Speed Test (S-S): This test was used to assess maximum anaerobic power, which is expressed as $W{\bullet}kg^{-1}$. This test uses different braking strengths which provoke different pedalling speeds with the aim of achieving maximum power[20]. The participants performed four 7-second cycles against an increasing braking force (2,3,4 and 5 kg) on a cycloergometre (Ergomedics 874, Monark, Sweden) which were broken up with 5-minute rest periods.

Wingate test: The Wingate test[21] was performed using the same cycloergometre as the strength-speed test. Participants were required to pedal as fast as possible for 30 seconds against a braking force that was determined by the sum of the body mass in kg by 0.075. The average power (Paverage) was calculated as the average power during the 30s period and was expressed as $W{\bullet}kg^{-1}$.

Statistical analysis

The statistical analysis was performed using the IBM SPSS v.20.0 programme (SPSS, Chicago, USA). The data was expressed as an average and standard deviation of the average (SD). To observe the possible differences between the age groups in the physical and physiological characteristics, a variance analysis was used of one factor (ANOVA) using the Tukey process as a post hoc analysis. The significance level was set at $\alpha = 0.05$, and the difference of the average along with the confidence intervals of 95% (CI) was calculated when the post hoc was necessary. Furthermore, the discriminant analysis was used for the physical and physiological characteristics with the age group variable as dependent.

Results

Table 1 reveals the physical characteristics and body composition of the different age groups.

Table 2 reveals the physiological characteristics of the different age groups.

Table 3 reveals the heart rate response of the different groups in two of the tests undertaken.

Discussion

The aim of this study was to observe the possible variations in anthropometric, physical and physiological parameters during the growth and formation process over the years of handball training, observing them within different age groups. These changes have been observed across all the groups, suggesting that the subjects tend to improve their performance and body composition with age. The results reveal significant differences when comparing all the ages (Tables 1, 2 and 3).

The average values of the body composition parameters reveal significant differences (<15, <18 and adults), especially in body mass, height, BMI, FFM and WH Ratio (Table 1). The results on an anthropometric level are aligned with the values shown in previous research studies, highlighting an increase in height with age (Table 1). More

Table 1. Physical characteristics and body composition in adolescents and adults according to age group.

	<15 years (n=32)	<18 years (n=26)	Adults (n=38)	ANOVA
Age (years)	13.8±0.7†‡	16.3±0.7*‡	26.8±5.6*†	$F_{(2.93)}$ = 130.94, p<0.001, η^2=0.738, Large SE
Body mass (kg)	64.7±12.3†‡	72.2±9.1*‡	87.5±8.3*†	$F_{(2.93)}$ = 47.52, p<0.001, η^2=0.505, Large SE
Height (m)	1.70±0.08†‡	1.77±0.08*‡	1.85±0.07*†	$F_{(2.93)}$ = 36.96, p<0.001, η^2=0.444, Large SE
BMI ($kg.m^2$)	22.4±3.8‡	23.0±2.4‡	25.7±2.2*†	$F_{(2.93)}$ = 12.98, p<0.001, η^2=0.218, Large SE
BF (%)	18.7±6.1	16.9±4.5	18.3±3.6	$F_{(2.93)}$=1.07, p=0.348
FFM (kg)	52.1±7.6†‡	59.8±6.6*‡	71.4±5.6*†	$F_{(2.93)}$ = 75.96, p<0.001, η^2=0.620, Large SE
WH ratio	0.77±0.04‡	0.78±0.05‡	0.81±0.04*†	$F_{(2.93)}$ = 10.81, p<0.001, η^2=0.188, Large SE
Endomorph	4.5±2.2	3.7±1.5	3.8±1.1	$F_{(2.93)}$=2.10, p=0.128
Mesomorph	4.7±1.4	4.6±1.2‡	5.4±1.1†	$F_{(2.93)}$ = 4.08, p=0.020, η^2=0.081, Medium SE
Ectomorph	2.7±1.6	2.7±1.2	2.0±0.9	$F_{(2.93)}$ = 3.61, p=0.031, η^2=0.072, Medium SE

BMI: body mass index; BF: body fat; body fat percentage; FFM: fat-free mass; WH ratio: waist-hip ratio; SE; size of the effect. The symbols *, † and ‡ show the difference between <15, <18 and adults, respectively.

Table 2. Physiological characteristics in adolescents and adults.

	<15 years (n=32)	<18 years (n=26)	Adults (n=38)	ANOVA
PWC_{170} ($W.kg^{-1}$)	2.25±0.77†‡	2.98±0.76*	3.04±0.67*	$F_{(2.90)} = 11.54$, $p < 0.001$, $\eta^2 = 0.204$, Large SE
P_{max} ($W.kg^{-1}$)	12.2±2.6‡	12.6±2.6	13.9±2.0*	$F_{(2.88)} = 4.43$, $p = 0.015$, $\eta^2 = 0.091$, Medium SE
$P_{average}$ ($W.kg^{-1}$)	7.2±1.2†‡	8.2±0.7*	8.4±0.5*	$F_{(2.86)} = 19.60$, $p < 0.001$ $\eta^2 = 0.313$, Large SE
SAR (cm)	17.6±7.8‡	19.3±9.3	23.4±9.0*	$F_{(2.93)} = 4.11$, $p = 0.020$, $\eta^2 = 0.081$, Medium SE
MS ($kg.kg^{-1}$)	1.17±0.26‡	1.30±0.23	1.34±0.18*	$F_{(2.93)} = 5.51$, $p = 0.006$, $\eta^2 = 0.106$, Medium SE
SJ (cm)	26.4±5.2‡	29.4±5.6‡	33.9±4.9*†	$F_{(2.90)} = 18.04$, $p < 0.001$, $\eta^2 = 0.286$, Large SE
CMJ (cm)	27.7±5.4‡	30.2±5.8‡	35.8±5.4*†	$F_{(2.90)} = 19.33$, $p < 0.001$, $\eta^2 = 0.300$, Large SE
ABK (cm)	32.8±6.8†‡	37.4±6.4*‡	43.6±5.7*†	$F_{(2.90)} = 24.94$, $p < 0.001$, $\eta^2 = 0.357$, Large SE
Bosco ($W.kg^{-1}$)	23.6±5.1†‡	29.7±5.2*‡	34.3±6.0*†	$F_{(2.90)} = 32.10$, $p < 0.001$, $\eta^2 = 0.416$, Large SE

PWC170: physical work capacity at 170 beats-min[1]; P_{max}: maximum estimated power in the strength-speed test; $P_{average}$: average power during the Wingate test; SAR: sit-and-reach test; MS: manual strength: SJ: squat jump; CMJ: counter movement jump; ABK: Abalakov jump; SE: size of the effect. The symbols *, † and ‡ show the difference between <15, <18 and adults, respectively.

Table 3. Heart rate response in the Wingate and Bosco test on adolescents and adults.

		<15 years (n=32)	<18 years (n=26)	Adults (n=38)	ANOVA
WAnT	min^{-1}	186.1±10.1†‡	176.5±10.8*	173.0±12.2*	$F_{(2.86)} = 11.84$, $p < 0.001$, $\eta^2 = 0.216$, Large SE
	%	90.2±5.0†	86.7±5.3*	89.4±5.9	$F_{(2.86)} = 3.16$, $p = 0.048$, $\eta^2 = 0.069$, Medium SE
Bosco	min^{-1}	169.2±13.4†‡	156.5±12.9*	159.2±13.9*	$F_{(2.86)} = 7.32$, $p = 0.001$, $\eta^2 = 0.148$, Large SE
	%	82.1±6.5†	76.8±6.3*‡	82.1±6.7†	$F_{(2.86)} = 5.65$, $p < 0.005$, $\eta^2 = 0.119$, Medium SE

The symbols *, † and ‡ show the difference between <15, <18 and adults, respectively.

specifically, there are many studies that reveal an average height of around 1.68-1.75 m in <15 years[2],12, around 1.77 m in <18 years[22] and between 1.81 to 1.92 m in adults[3,7,10,23]. Similarly, statistically significant differences have been revealed in the height between elite-level and lesser-level players[23]. This could indicate that the biological maturity of the players is not attained until adulthood.

Likewise, the evolution of the body mass is related to the age of the handball players (Table 1). In literature, these values are positioned between 40 to 70 kg in <15 years[2,11]; around 69 kg in <18 years and between 78 to 96 kg in adults[2,3,5,7,10,23-25]. Savucu[26] suggest that taller and heavier handball players have the capacity to reach greater speeds in jumping throws, which is essential in this sport.

Similar to the previous anthropometric variables, the average BMI results were very similar in comparison to previous research studies. In <15 years the data range is made between 22 to 23 kg/m^2[(2)], in <18 years at around 22 kg/m^2[(22)] and between 24 - 25 kg/m^2 in adults[3,7,9,10]. Although BMI can be an erroneous indicator when determining the degree of obesity[27], it is true that it can offer valuable information when observing the evolution over age, and, at the same time, studying the relationship between the BMI and body fat, as indicated in other team sports[28]. According to Visnapuu and Jürimäe[22], another important factor regarding the body composition parameters is that height, body mass and the BMI are more important in handball players than other variables, for example hand grip strength.

The evolution of body fat with age does not follow the same pattern as the previous variables (Table 1). In fact, our data does not match with that described by Ibnziaten *et al.*[11], who propose that body fat percentage decreases with the age and competitive level of handball players, similarly to other team sports such as football[28]. Our values were similar to those put forward by Nikolaidis & Karydis[29], who indicated that the evolution of body fat with age did not have to be linear. In addition, the body fat findings are slightly higher than those in previous studies in which for <15 years it was positioned between 14 to 16%[11], and in adults between 11 to 15%[3,5,7,10,23-25]. A high percentage of body fat has a negative effect on performance and health in team sports[28], which is why both players and trainers alike should be take it into consideration.

Fat mass is also an interesting parameter with regards to growth[30]. Fat-free mass increases throughout the age groups established in this study, just as indicated in previous studies[11,28]. Specifically, the group of adults (71.4 kg) is aligned with the suggestions of other studies that position it between 65 and 82 kg[3,5,29,31]. In our study, there are highly significant differences between the groups, which are even more notable than the WH ratio increase towards adulthood. In previously conducted studies, it has been observed how elite players were taller and had more fat-free mass than amateur players[32]. Ibnziaten *et al.*[11] indicate a possible causal relationship between training throughout childhood and adolescence and a tendency to have a healthier constitution, i.e. less body fat and more muscle mass. It has been suggested that differences in fat-free mass may lead to greater differences in variables such as strength and power, which result in an improvement of the muscle mass towards adulthood. Vila *et al*.[4] indicate that muscle mass is important for handball players, as greater muscle weight and strength may be an advantage when tackling defenders on the 6-metre line. Greater strength and maximum power in elite players implies having an advantage in basic handball actions, such as blocking, hitting, pushing and gaining possession[33].

Endomorphic and ectomorphic components of the somatotype reveal significant values between <15 years and <18 years, with no differences among adults (Table 1). However, the mesomorphic component increased notably within the <18 years group and the adult group. Similar results were found by Nikolaidis y Karydis[29], where the endomorphic and ectomorphic factor reduced throughout adolescence, whilst the mesomorphic factor increased.

Bayios *et al.*[34] revealed that handball players had higher values in the mesomorphic and endomorphic component and less in the ectomorphic component than basketball and volleyball players, aligned with our results (Table 1). In turn, if this data is observed with other team sports, it can be seen how handball players have higher values in body fat, an endomorphic and mesomorphic component, even more apparent when comparing sexes[4,29,30,34,35]. Likewise, the lowest value was obtained in the ectomorphic component (Table 1), aligned with the results displayed in Vila *et al*.[4]. Numerous authors have reinforced this fact, indicating that the anthropometric characteristics of handball players are important because there are repeated physical contact actions and a large number of collisions, meaning that small differences in these components may or may not be an advantage[9].

Physiological characteristics

An increase is observed with the progression of age in all the variables related to the functional assessment of the player (Table 2). For example, regarding hand grip strength, values have been found in players of around 171 and 285 N in those under 15 years and between 414 and 472 N in under-18s[22], observing an increase with the progression of age. These differences in hand grip strength in elite players are higher when compared to amateur players[32]. Accordingly, significant differences have been found between under-15s and adults. HGS seems to be related to anthropometric parameters, in which it has been observed that the taller players with greater body mass are more likely to have better results in this variable[22]. Therefore, controlling this parameter could be useful for trainers. The essential capacity of gripping the ball should not be overlooked in handball[4], which is why strength seems to be crucial in the success of this sport, with the aim of throwing and controlling the ball during the game. These conclusions are compatible with other studies, which indicate that throwing speed and precision are considered some of the most important elements in handball[32], aspects linked to the ability to grip, therefore obtain a high value in the hand grip strength test.

The average values of the sit-reach test reveal that the result increases from young people to adulthood. The results obtained may seem low (Table 2), but they are within those proposed by other authors. The data oscillates between 15 to 34 cm in under-15s, with the best of the 18 years at around 32 cm. The results in women are higher in both ages, between 31 and 39 cm[2,8,12,28]. It is curious that the values continue to increase, without any statistical significance between the under-15s group and the 18-years group, but with significance in the adult group (Table 2). This variable is interesting because the increase is of approximately 24% from <15 years to the adult group. It may be that over the years, handball training improves this quality due to the specific nature of the training. It is true that one of the limitations of this study is that the training load performed by the players has not been assessed, i.e. the amount of training targeting strength or resistance. Therefore it would be interesting to assess this because in a quality that tends to reduce over time, its increase may be due to a greater training load as the specialisation increases.

It has been observed that jumping capacity increases depending on the age group in all the jumps assessed (Table 2). The adult players achieved SJ values of around 32-35 cm, similar to results from other studies[36]. In terms of the CMJ, similar results were gathered to those for under-15 years football players, between 30 to 34 cm[28], and in adults with a range between 34-40 cm[3,36,37]. A sport like handball entails jumping as high as possible and throwing at maximum speed[3,12,26], therefore it is logical that over the years of training these variables increase. Our results reveal that muscle mass seems to be an important factor that is fundamentally linked to jumping performance. In accordance with this, Sporis and Vuleta[10] highlighted the association between weight and fat mass with the jump test. Therefore, these results show the importance of developing jumping capacity from adolescence, controlling the improvement in the muscle mass for greater success in the adult phase.

Performing an analysis over time, it can be seen how percentages of improvement in the <15 years to the <18 years is in an interval of 8-12%; with the difference in the adult group being around 22-24%. As such, jumping capacity increases gradually with age and with the level of specialisation.

In this respect, regarding power, the improvement with age obtains higher values, i.e. changes of 20% in the younger groups and up to 31% improvement for the adult group. It is acknowledged that training programmes of between 6 and 10 weeks can improve power[38]. Souhail *et al*.[39] reveal how aerobic power is related to the distance covered during the game; and in this respect an adult player covers twice as much distance as adolescents in a game[40]. Considering the intermittent nature of this team sport, it has been claimed that performance is associated with the capacity to produce high power output for a short length of time (anaerobic power) and the capacity to recover between these high intensity actions (aerobic power)[41]. This can be observed in the statistically significant differences between the age groups (Table 2), marking greater differences between formation and the group of adults in this quality than in a jump.

In turn, a cardiovascular adaptation can be observed with increasing age (Table 3). Wagner *et al*[42] highlight the need to control cardiovascular parameters due to their significant implication in handball competition. This is a hugely important parameter in being more effective in the game. The differences between groups, despite being significant, are more marked than in other qualities.

Therefore, the anthropometric and physiological values are very similar to existing data in literature for handball players of the same age, however, from our point of view trainers should focus on some parameters that may be highly useful. Firstly, some anthropometric characteristics should be considered (for example taller players with greater mesomorphic component and less FFM), because it is likely that this profile will perform better in the future. Databases that include information about different ages could facilitate benchmark values for the trainer and the player's evolution over time. Secondly, power and strength data should be noted, as improvement percentages throughout the age groups may be useful as a starting point to understand the evolution of these variables in handball players, and this may allow for better planning over time. The majority of the findings in this study focus on the importance of training over the years, physical, physiological and anthropometrical improvement,, especially regarding jumping performance, muscle mass and less FFM, which are vital in successful handball.

Therefore, it can be concluded that there are differences between the age groups, within which certain anthropometric features stand out (tall players, greater mesomorphic component and less FFM), greater jumping capacity in their different variants that can be seen in around 22-24% for adults; whilst potential is revealed at around 30%. A notable consideration is increased flexibility over time; as well as a more efficient sub-maximum heart rate over the years. This data may contribute to enhancing the understanding of trainers regarding the evolution of the physical and physiological characteristics in a speciality such as handball.

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