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Anthropometric and Physical Characteristics of Elite Team Handball Players According to Axes and Lines Playing Positions

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ABSTRACT

The purpose of this study was to compare (i) anthropometric data and physical performance characteristics between different axis and lines playing positions of professional team handball players and (ii) performance profiles between 1st division and national Tunisian team handball players. Forty four male professional handball players with a mean age of 22.09 ± 2.56 years and 12 years of playing experience at national level participated in this study. Measurement of anthropometric data, repeated sprint ability, jumping performance, and endurance performance were determined and analyzed with respect to axis and lines playing position.

The result showed that players of national team were taller ($p<0.05$), had significantly ($p<0.01$) better performance in squat and countermovement jump and a higher ($p<0.05$) maximal oxygen uptake. Similarly, players of central axe reached highest size, weight and thin mass. Players of lateral axis had higher, maximal oxygen uptake, maximal speed and jumping performance. While, players of rear lines reached highest age.

These results demonstrate that international players were characterized by highest average of age, size, jumping performance and maximal oxygen uptake than those of 1st division team. Players of latéral axis reached the best performances in endurance and jumping performance than players of central axe. However, Play makers and pivots reached highest size, weight and thin mass.

KEYWORDS: Handball, Playing positions, anthropometric, physical

INTRODDUCTION:

Handball is an Olympic contact sport that requires a high standard of preparation in order to complete 60 mins of competitive play and thus to achieve success. Hence, physical characteristics of players have become major fields of interest for many trainers and sport scientists. In response to different offensive and defensive situations, players have to develop aerobic and anaerobic capacities as jumping, feinting, blocking, sprinting and throwing (Gorostiaga et al 2007). Those characteristics are considered as important aspects of the game that contribute to the high performance of the team (Marques & González 2006). Furthermore, anthropometric parameters are also considered as one of the biological determinants of performance. Marques and González (2006) demonstrated appropriate morphological structure in top handball is highly beneficial especially in terms of efficient execution of individual skills related to individual playing positions. Therefore, in top-quality team handball it would be sensible to select players whose morphological profiles are most compatible with positional specificities in the demands of the game (Srhoj, Marinović and Rogulj 2002).

Rannou, Prioux, Zouhal and Delamarche (2001) found that in the game, the players perform different tasks with different physical demands depending on their playing position. Indeed, wings seem to cover the longest total distance and the longest distances while sprinting, while backs seem to execute the largest number of throws[13]. Studies examining top-level players have shown that backs are the tallest players with the largest arm span; wings are the shortest players of the team, while pivots are the heaviest with the highest body mass index (Ohnjec, Vuleta, MilanoviW and GruiW 2003).However, no study investigated whether there are any differences among playing positions according to axes and lines. Recent changes to the game rules and the implementation of the "fast center" have placed greater tactical demands on handball players. This finding relates to the attack end conduction after interchanging of position. The conduct of attacks by players of the same axis or lines depends on their ability to adjust their behaviours to the changes that occur over time in the offensive context of the handball game. In fact, the left rear can change the three positions in the back line and even a player of the front base.

Therefore, the purposes of this study were twofold: (i) to determine differences in anthropometric data and physical performance characteristics between handball players at different playing positions (front and rear lines, central and lateral axes); (ii) to analyse the existence of profile differences between players of different competitive level.

MATERIALS AND METHODS:

PARTICIPANTS:

Forty-four male handball players with a mean age of 22, 09 ± 2, 56 years, participated in this study, which was conducted during the season 2011-2012. All players usually train five sessions of handball per week and played regularly in matches during the week at national or international level.

Players were classified into two groups: national team (n=22), international team (n=22). Then, all players were dissociated according to their playing positions: front line (n = 11), rear line (n = 11), central axis (n = 11) lateral axes (n = 11). The goalkeepers were not included in this study.

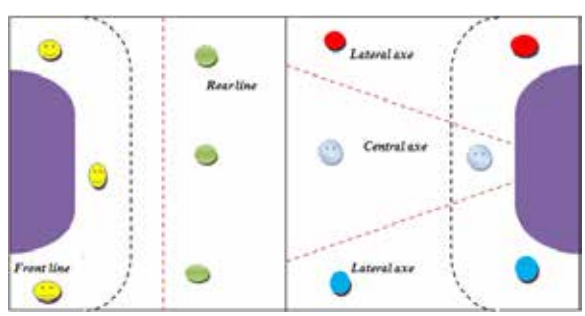


Figure n°1: Displacement of players according to axis and lines playing positions

National players were members of the highest professional Tunisian handball Championship teams (during the season 2011/2012), called the 1st national division. International players were members of the Tunisian handball national team. Data collection took place in the second part of the season, after the first phase of the Tunisian handball Championship (February and March) to ensure that all athletes would be in a state of good overall performance. All subjects have a Tunisian origin, were non-smokers and none were ergogenic aid or medication users known to affect cardio respiratory function during the study. The protocol of this study was in accordance with the guidelines of the Ethical Tunisian Olympic Committee, and all participants gave their written consent.

PROCEDURES:
The subjects were tested on three testing days. Each player visited the laboratory of the Sports Medicine Centre of the Ksar-Said Institute of Physical Education in the morning on 3 separate occasions, and to refrain from exercise, also 24h before the study. The laboratory conditions of temperature and humidity (20 to 22 °C and 50 to 60%, respectively) were kept stable.

The first day of testing comprised the medical checking, anthropometrical measurements and endurance performance. Anthropometric measurements consisted of six variables: skin fold thickness, body height, and body mass. To evaluatebodydimensions a stadiometerwith a range scaleof 0.50 cm wasusedandbodyweightwasmeasured to thenearest 0.1 kg using a digital scale (WeightTronix, New York, USA). The body fat percentage was estimated by the sum of four skin fold thickness (biceps, triceps, sub-scapular, suprailiac) determined by the formulas of Lohman (1981). All skin fold measurements were made in triplicate by the medical center physician according to the International Working Group on Kin anthropometry methodology, described by Ross and Marfell-Jones (2007). Body mass index was calculated as Wt (kg)/Ht (m) ^{2}, fat mass (FM) as Wt (kg)*%body fat, and thin mass as Wt (kg)-FM (kg).

The Yo-Yo intermittent recovery test was conducted on the second day of testing. This test evaluates an individual's ability to repeatedly perform intervals over a prolonged period of time, particularly for athletes from sports such as tennis, team handball, basketball and soccer or similar sports. The athlete's score is the total distance covered before they were unable to keep up with the recording. The VO2max was estimated according to the Bangsbo, Marcello and Krustrup (2008) formula:

VO2max (ml/min/kg) = distance in meter x0.0136+45. End heart rates (HR max) and maximal aerobic speed (M speed) were also considered for analysis.

The Repeated Sprint Ability test (RSA) was performed on the third day under identical laboratory conditions. (Buchheit, Bishop, Haydar, Nakamura, and Ahmaidi 2010). It was assessed through six repetitions of maximal 2x15m shuttle sprints (~6s) departing every 20 s. During the 14 s recoveries between sprints, subjects had a passive standing recovery. Three seconds before starting each sprint, subjects were asked to assume the ready position and await the start signal. The speed was evaluated by using 2 pairs of photocells and reflectors connected with an electronic timer (Tag Hewers, Marin, Switzerland). The photocells were placed at shoulder height and the time was given in hundredths of a second.

After 5 days each participant performed four specific jumping tests: vertical jump (VJ), countermovement jump (CMJ), drop jump (DJ) and squat jump (SJ) (Ohnjec et al 2003). Prior to baseline tests, each subject underwent one familiarization session and was counseled on proper exercise technique, as well as stretching and an appropriate warm up. For each type of jump was allowed three attempts barefoot with 60 seconds of recovery. The best performance based on height (cm) was used for analysis. The jumping performance was collected by using an Optojump dispositive (Microgate SRL, Italy) connected to a personal computer, and 3 minutes of rest were used between each type of jump (Lidor, Falk, Arnon, Cohen and Segal 2005).

STATISTICAL ANALYSES:
All data for this study were analyzed using SPSS 16 computer software for Windows (StatisticalPackage for the Social Sciences, Chicago, IL). Data are presented as mean and standard deviations (±SD). TheKolmogorov-Smirnov test of normality and Levine's test of homogeneity of variance were performed to assess the normality of the distribution.. All differences between players were calculated by a Mann-Whitneytest. Inall cases the level of statistical significance was set at P<0.05.

RESULTS:
Meanand standard deviation of anthropometric indices, physical fitness and physiological characteristics of all subjects are summarized in table 1.

Table1: Anthropometric and physical characteristics of national team and 1st division Tunisian male hand ball players (n=44) (Values are mean ±SD)

Abbreviations: 1st div: 1st division players; Nat-players: National team players; VO2max = maximal oxygen uptake; A3; Players of central axis; A4: players of lateral axes; L1: players of front line, L2: players of rear line
* P<0.05; # P<0.01; ‡ P<0.001

Regarding differences between the playing classes, onecan note that international players are older(p=0.004)have a significant higher jumping performance insquatjump (p=0.006), countermovementjump (p=0.002), drop jump left(p=0.001) and also a higher VO2max (p=0.030). Howeverno differences were found (p = 0.05) between national and international players regarding bodymassindex, bodyfat, fatmassandthin body mass.

As regards the differences across the four playing positions, no significant difference swere observed between lines positions (p>0.05) withtheexceptionof age (p=0.008).Although, playersfrom central axesare taller (p=0.005),weightier(p=0.010) andhave a significantlyhigherthin bod ymass (p= 0.002)than lateral axesplayers. Moreover, central axesplayersare significantlybetterin countermovementjump (p =0.004), have ahigher VO2max (p=0.05) and better running speed times(p=0.040).

DISCUSSION:
Knowledge of the physical characteristics of handball players could provide insight into those individual factors that influence the players' performance in the game. Indeed, the literature have tended to suggest that certain anthropometric profile (body fat, body mass, muscle mass, body mass index), physical fitness performance (jumping, feinting, blocking, sprinting, eg.) and specific physiological characteristics (maximal oxygen uptake) influence athletic performance (Lidor et al 2005). Previous studies have sought to determine differences in morphological, physiological and physical performance amongmalehandball players in regard to different playing positions (goalkeepers, wing, left/right back, center back and pivot). However, most published research on this issue failed to specify differences among lines (front and rear line) and axes (central and lateral)players. Therefore, the key research question of this study was thus to determine differences in anthropometric, physical and physiological characteristics between these playing positions and additionally between athletic status.

The present study revealed significant differences in anthropometric and physical performance profiles between professional and national team players. It was found that national team players had a higher body size compared to 1st division players. However, no differences were found regarding weigh, body mass index, body fat, fat mass and thin mass. These results confirm that obtained by Sinning, Dolny and Little (2005) and Tumilty (1993).

Likewise, national team players showed the best results for jumping ability in countermovement jump (p=0.006), squat jump (p=0.002) and drop jump left (p=0.001). Conversely, Gorostiaga et al found no significant differences in vertical jump performance between amateur and elite players.This inconsistency may be due to the fact that in the two last mentioned studies, the two groups performed the same polymeric training program

Furthermore, the present study results showed that national team players had a highest VO2max than 1st division players. This finding supports previous research into this area which links improvements in endurance exercise capacitywith optimal concentration, technical skills and coordination (Sinning et al 1985.)

One of the most important results of the present study was the difference in size, weight and thin mass according to axes playing positions.

Pivots and playmakers reached the highest values. However; according to our data, the anthropometric characteristics of front and rear line players seem to be similar. Indeed we found that weight, body mass index, fat mass, thin mass and body fat percentage were not different between line playing positions. This finding is not in accordance with previous study involving young female center backs who were shorter than ather playing position group (Luig, Manchado and Perse 2008).

This is probably due to coaches' decision, for this age range to assign the taller players in back positions. Indeed a particular body size may be an advantage in certain match-play situation while disadvantage in other. However, it should be noted that rear lines players participate in the central defence field, aiming to block the opponents' shoots. These players are specialized in distant shots and very efficient in shooting at the goal over the defensive wall. According to several authors (Sinning et al 1985), one major requirement for this position is body height since it has a positive influence on all the body segments lengths and, in turn, athletic performance.

The vertical jump height itself is a good measure of specific muscular performance (anaerobic power) and it seems to be important parameter that influences success in handball matches. We found that players from the lateral axis had significantly better results in countermovement jump than the players of central axis (A3).Our data are in accordance with studies involving young female handball players (Rogulj, Srhoj V, Nazor , Srhoj and Čavala 2005).

A higher level of anaerobic parameters would be preferable and would reduce the risk for injuries and developed aerobic and anaerobic capacities as jumping, feinting, blocking, sprinting and throwing. Hence, performance of handball players in vertical jump test tends to show up influences of positional role and training stage. Such muscle performance characteristics would be determined by an optimal distribution of different fiber types but also by increasing playing competitively. However, more research is necessary to clarify.

A high aerobic uptake is required in team handball, as players have been reported to cover between 4-6.5 km per game, depending on their position and the competitive level of the teams. The aerobic system is the main source of energy provision during handball match-play and the average values of VO2 max for top-level handball players tend to be high, supporting the above statement (Reilly, Bangsbo, and Franks 2000).

While VO2max values may be influenced by differences in standards of play, training regimes and the phase of season, team with superior aerobic fitness would have the advantage, being able to play the game at a faster pace throughout (Ramadan, & Byrd 1987).Higher level of endurance capacity (higher VO2 max, lower HRmax) will give elite players a better base for on-field performance regarding intensity and demands of handball match-play. The present study also found that lateral axes had a greater estimated VO2max ($P < p=0.05$) and maximal speed ($P < 0.04$) from all other playing positions. No significant difference was observed between front and rear line which is in general agreement with previous data (Wisløff, Helgerud, and Hoff 1998). It is reported that lateral axes wish composed from wings, left and right backs cover significantly greater total distance during the game than other players cover the smallest total distance (Fábrica, Gomez, and Fariña 2008). A high aerobic fitness is important for wings and backs as they are the players who perform the most picks and require high levels of aerobic capacity to aid recovery after bouts of high-intensity activity. In addition, it has been reported that players during the game should maintain the ability of the optimal output in shooting and throwing effectiveness regarding aiming accuracy or ball velocity (Rogulj and al 2005).

Performances recorded in repeated sprint ability test and vertical jump were similar for all playing positions. These finding are in disagreement with previous studies that found that wings are the fastest players of elite adult male female and young female teams, followed by backs (Rogulj and al 2005).. Sprinting velocity for short distances is an important component for optimal performance in team handball. Players are required to cover distances from 20 to 30m with maximal speed in the transition from defence to offense or, after a ball loss, to prevent a fast break. Studies have shown that wings and backs spent 14% and 4% of the total playing time running with speed higher than 3.5 m/s and 5.2 m/s respectively (Zapartidis, Gouvali, Bayios and Boudolos 2007). As occurred in the overall data, there were no significant differences between the front and the rear lines in any of the physical or physiological tests.

CONCLUSIONS AND PRACTICAL IMPLICATIONS:

It was found that players from national team had a higher body size, improved VO2max and a higher jumping performance in several types of jumps than 1st division players.

The results also demonstrate that some anthropometric, physiological and physical fitness differences exist among axes playing positions. The best performance in physical abilities and physiological characteristics was observed in the lateral axes.

Coaches and trainers can effectively use the same program to develop more effective defensive and offensive strength and conditioning for players from front and rear lines playing positions.

From a practical standpoint, this information is important for coaches and trainers to adjust training regimes and concentrate on the variables that are specific to improve performance and achieve success in handball.

Achievement of high performance is a result of systematic special training specific for all playing positions and should not be neglected by the coaches.

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CONFLIT OF INTERESTS: None

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