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Does Aerobic and Anaerobic Power of Players Differ According to Playing Areas?

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Abstract: This study was conducted in order to make a comparison between aerobic and anaerobic power of handball players playing in different positions such as play-maker, winger players, pivot and goal-keeper. 56 Handball-players playing as a play-maker (right, left and center), winger players (right and left), pivot or goal-keeper in university handball teams whose ages ranged between 18 and 25 and who have been practicing for at least five years or more participated in the study on a voluntary basis. The participating handball-players were evaluated for their aerobic and anaerobic strength. The differences between aerobic and anaerobic strengths of players according to their position on the court were calculated in arithmetic average and standard deviation. Unidirectional variance analysis (post-hoc Tukey) was conducted in determining the differences of players according to their positions on the court. The significance level was taken as $p<0.05$. The differences between body height, body weight and body-mass index and aerobic and anaerobic strength values of handball players were found to be significant ($p<0.05$) when a comparison was made according to handball players positions on the areas.

Key words: Handball-Player · Aerobic Strength · Anaerobic Strength

INTRODUCTION

Success is the target to be achieved in the world of sports. It is always the goal of all athletes to win any competition they get involved in. Athletes want to become speedy, strong and resilient and to have a perfect technique and to become successful as a result of highly-loaded exercises and trainings which they carry out tirelessly and devotedly. Furthermore, athletes also want to be stronger, speedier and more resilient in order to further improve their performance [1]. Physical, physiological, psychological and motor skills and attributes of athletes therefore need to befit to the sport they are performing. If an athlete possesses such skills and attributes, success can be achieved when these skills and attributes are well-organized and trained [2,3].

Handball, with millions of practitioners all around the world, is a fast and enjoyable game for both men and women. As is the case for all team-sports, basic motor skills including strength, pace, stamina, agility and coordination [4] and parameters such as technique, tactics and experience play an important role in achieving success given the time of the game and the need for playing fast and accurate [5]. However, when we inquire how dominant these motor skills are in handball, strength and pace come first in the priority ranking [6]. Success comes in handball through a systematic development of these skills, supplemented by parameters such as shooting strength and jumping strength where anaerobic capacity is dominant [6-9].

Handball is a fast game due to the relatively small size of the ball. In addition, it ranks among the team competitions in the second place after football in terms of the size of the court and time of the game. From such a point of view, handball players need to be at the highest level in terms of both aerobic and anaerobic strength [10]. Anaerobic strength is defined as the capacity of the organism to work without oxygen where the organism cannot take in sufficient amount of oxygen but still continues to work [11-13]. For aerobic strength which can be defined as the maximal amount of oxygen consumed per a minute during maximal exercise, expressions such as

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maximal oxygen consumption ($MaxVO_2$), aerobic capacity and etc… can be used in exercise physiology to point to the same concept [11-14]. $MaxVO_2$ depends on transportation of O_2 by the cardiovascular system to the working muscles where it is consumed by cells to generate energy [15]. Researches indicate that both aerobic and anaerobic strengths are improved through regular exercise [10]. This study was conducted in order to make a comparison between aerobic and anaerobic power of handball players playing in different positions such as play-maker, winger players, pivot and goal-keeper.

MATERIALS AND METHOD

Play-makers (right, left and center n=18), winger players (right and left n=14), pivot (n=12) and goal-keepers (n=12), 56 in total-who play in the second division participated in the study on a voluntary basis. The participating handball players were measured for their body height, body weight, body mass index (BMI) and aerobic and anaerobic power. The ID-card information was taken as basis to determine the ages of players. Body height of player was measured by means of a meter (Rodi Super Quality) in cm terms and their body weight was measured (with their shorts and t-shirts on) by means of an electronic weighing machine (premier) in kg terms. The body mass index was calculated through the formula of Body Weight (kg) / Body Height (m^2). Handball players were also measured for vertical jumping. The vertical jumping value was determined by calculating the difference between the distance achieved by the player in standing and the distance achieved by the player in jumping. The vertical jumping value P = v4.9 (w) vD was put in the formula [P=Anaerobic power (kg/m/sec), W=Body Weight (kg), D= Jumping Distance (m)] to determine the anaerobic power of the player. For the aerobic power, the participating players were given the cooper test. The values obtained were used in the Balke Formula ($MaxVO_2$ = 33.3 + (X*-150) x 0.178 ml/kg/-min) to determine the aerobic power (*distance run in 1 minute) [16]. Results of the measurement were presented as average and standard deviation ($\bar{x} \pm SS$). ANOVA (post-hoc Tukey) was implemented to determine the difference among groups. SPSS (Statistical Package for the Social Sciences) 13.0 was used for data evaluation. $P<0.05$ value was considered significant.

RESULTS

An analysis of the tables would show that the differences between body height, body weight and body-mass index and aerobic and anaerobic strength values of handball players were significant ($p<0.05$) when a comparison was made according to their positions on the court. The differences between groups in the same column but bearing different letters were found significant according to the positions of players. It was found that aerobic capacity was at the highest in wingers whereas playmakers had the highest anaerobic capacity.

Table 1: Age, Height, Body Weight, BMI, Aerobic and Anaerobic Power Results Considering Playing Areas

	Goal-keeper (n=12)	Pivot (n=12)	Winger players (n=14)	Play-maker (n=18)
Areas	Mean±SD	Mean±SD	Mean±SD	Mean±SD
Age (year)	21.75±2.63	20.58±1.88	21.33±1.55	21.22±1.76
Height (cm)	178.16±4.66	180.58±5.21	176.00±5.00	183.11±4.15
Body Weight (kg)	83.91±11.44	86.00±12.91	74.00±9.13	84.00±5.24
BMI (kg/(m)^2)	26.37±3.04	26.43±4.34	23.84±2.24	25.04±1.07
Aerobic power (ml/dk/kg)	45.25±3.49	46.16±3.88	55.91±4.31	52.88±3.49
Anaerobic power (kg-m/sn)	142.66±6.66	136.33±5.33	136.58±6.98	150.33±5.21

Table 2: Height, Body Weight and BMI Results Considering Playing Areas

		Height (cm)	Body Weight (kg)	BMI (kg/(m)^2)
Areas	n	Mean±SD	Mean±SD	Mean±SD
Goal-keeper	12	178.16±4.66^a	83.91±11.44^a	26.37±3.04^a
Pivot	12	180.58±5.21^b	86.00±12.91^a	26.43±4.34^a
Winger players	14	176.00±5.00^a	74.00±9.13^b	23.84±2.24^b
Play-maker	18	183.11±4.15^b	84.00±5.24^a	25.04±1.07^a
F		6.161	3.384	2.409
P		p<0.001	p<0.015	p<0.048

^{a,b} the different letters in the same column refers to which group the difference stem from ($p<0.05$, $p<0.001$)

Table 3: Aerobic Power and Anaerobic Power Results Considering Playing Areas

Areas	n	Aerobic Power Mean±SD	Anaerobic Power Mean±SD
Goal-keeper	12	45.25±3.49[a]	142.66±6.66[a]
Pivot	12	46.16±3.88[a]	136.33±5.33[b]
Winger players	14	55.91±4.31[b]	136.58±6.98[b]
Play-maker	18	52.88±3.49[b]	150.33±5.21[c]
F		23.622	18.342
P		p<0.001	p<0.001

[a,b,c] the different letters in the same column refers to which group the difference stem from (p<0.001)

DISCUSSIONS AND CONCLUSIONS

In this study which was conducted in order to make a comparison between aerobic and anaerobic capacities of handball players according to their positions, it was found that there were some differences among players according to their positions on the court. When we compared our findings with the existing literature, we came across both similarities and differences.

Our findings showed that the average values of body height, body weight and body-mass index values are lower in wingers than players in other positions. Body weight decreases due to burning of high amount of calories during the exercise [17]. Given the fact that wingers make more distance than other players during the game, our findings are in line with this principle as wingers have lower body weight and body-mass index.

In this study, the differences between aerobic and anaerobic capacity of handball players according to their positions were found to be significant. It was also found that aerobic capacity is at the highest in wingers while play-makers have the highest anaerobic capacity. Sınırkavak *et al.* [18] found that the aerobic capacity of handball players was 32.41±1.87 ml/min/kg. Eler [3] determined that anaerobic strength average in handball players was 124.76±14.41 kg-m/sec. Koç [10]found that the aerobic capacity in handball players in the same age group 43,38 ml/min/kg and the anaerobic capacity as 146,25 kg-m/sec. They also found that there were increases in aerobic and anaerobic strength values of the continuous and interval exercise programs [19]. Yamaner *et al.* [20] found in their study on determination of physical and physiological attributes of defense and offense players in a male handball team that anaerobic strength was 127±5.64 kg-m/sec in offense players whereas 135±6.74 kg-m/sec in defense players.

An analysis of the literature has shown that the mid-level anaerobic strength values of male players between ages of 20 and 30 are 140-175 kg-m/sec while high-level values are 176-210 kg-m/sec. [13].

It also indicates that the center players and wingers are not within in this reference interval whereas goalkeepers and playmaker are within this interval. Rannou *et al.* [21] have shown that anaerobic metabolism is as important for handball players as it is important for sprinters; anaerobic metabolism has a significant impact on performance and handball is a game involving highly-intensive contact and mobility with short resting periods.

As a conclusion, it is considered that an intensive practice of the jumping strength which is based on the muscular power of lower extremities by playmakers would make contribution into anaerobic power. We do also consider that the increased aerobic power of wingers is due to the longer distance they make during the game.

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