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Examination of Characteristics of Anthropometric and Physical Fitness of 10-12 Years Old Handball Players

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Abstract: The purpose of this study was to investigate characteristics of the anthropometric and physical fitness of the handball players, whose play in the club teams. A total of 60 handball players, as 30 males with 11.57±1.85 years of average age, 164.39±5.71 cm of average height and 44.19±6.74 kg of average body weight and 30 females with 11.62±1.03 years of average age, 151.68±6.18 cm of average height and 43.12±4.96 kg of average body weight voluntarily participated in this study. While it was found out that the difference between the averages of the anthropometric measurement values of the subjects who participated in the study are statistically significant in height measurements ($p<0.001$) and in skinfold and bone diameter measurements other than abdominal, thigh and calf skinfold ($P<0.001$, $p<0.05$), in circumference measurements the differences between shoulder, chest, back, abdomen, hip and thigh averages are not statistically significant ($p>0.05$), but in all other parameters the differences between the averages are significant ($p<0.001$, $p<0.05$). As a result of the comparison of the performance tests carried out in order to determine the physical fitness of the subjects who participated in the study, it was found out that the differences in handgrip strength ($p<0.05$), leg strength ($p<0.05$), 20-meter dribbling ($p<0.001$) and 30-meter speed ($p<0.001$) tests are statistically significant.

Key words: Handball · Anthropometry · Physical fitness · Performance · Maximum oxygen consumption

INTRODUCTION

Data obtained from international sports matches today indicate that success in sports is not achieved by coincidence. In consideration of this, the criteria necessary for achieving success in sports should be determined. Selection of athletes who possess physical fitness and the somatotype structure suitable for a given branch of sports and in order to achieve success in the future making this selection in the early ages of the athletes is among the most important ones of these criteria. In parallel with technological and scientific developments, sports have also turned into a competitive field all around the world. The winning team or athlete is determined with ever smaller differences. Determination of potential success in sports will form a basis for orienting the athletes to the right branch of sports and for achieving optimum success.

Handball is a complex branch of sports including players with advanced aerobic and anaerobic capacities [1,2]. Some motor skills such as sprinting, jumping, flexibility and shooting speed are acknowledged as attributes that contribute to the high performance of the team [3,4]. On the other hand, the anthropometric attributes in the modern handball player model play a supportive role to high performance under the real competition conditions [5,6]. Height, body mass index, hand and hand length are important in terms of performance of athletes and considered as the basic criteria in selection of athletes [5]. A wider hand surface and hand length affect motor skills such as dribbling, passing, catching and ball throwing and contributes in maximum throwing speed [6]. In modern sports international competition now includes younger ages. Assessment of the performances of young athletes is based on physical fitness and anthropometric parameters that provide a clear view of players' quality and that constitute the criteria for promoting to a higher level.

Purpose of this study was to determine the skill levels of male and female handball players between the ages of 10 and 12 and to determine the differences between the genders by examining their respective anthropometrical

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and physical fitness attributes. Also due to the fact that the number of the studies focusing on this age group is not much in the literature, it is intended that this study will serve as a contribution to the related literature and will aid coaches in selecting athletes at their early ages and in preparing training programs.

MATERIAL AND METHOD

Subjects: A total of 60 handball players as 30 males with 11.57±1.85 years of average age, 164.39±5.71 cm of average height and 44.19±6.74 kg of average body weight and 30 females with 11.62±1.03 years of average age, 151.68±6.18 cm of average height and 43.12±4.96 kg of average body weight voluntarily participated in this study. All players participated at the league matches according to their age groups and performed 3 training sessions per week. All players and their parents were informed about the procedures of the measurements and have given written consent for participating.

The subjects were asked not to engage in intense physical activities and not to change their nutritional habits during the 48 hours before the measurements and during the measurements.

Testing Procedures: All anthropometric measurements were carried by the same researcher and on the basis of the Anthropometrical Standardization Reference Manual [7]. Weight measurements were carried out with TANITA (TBF-300 Model) equipment at 0,1 sensitivity and height measurements were made with a stadiometer with 0,01 sensitivity. Skinfold measurements were carried out with holtain skinfold caliper (Holtain United, Dyfed, UK), length measurements with a sliding anthropometer and finally circumferences were measured with an inflexible measuring tape.

Skinfold measurements were taken from a total of 5 areas as biceps, triceps, subrailiac, subscapula and calf areas, while length measurements were taken from total 3 areas as sitting height, fathom length and hand length, diameter measurements from total 4 areas as bitrochanteric, biacromial, femur and humerus bicondylar and circumference measurements were taken from a total of 11 areas as shoulder, chest, abdominal, hip, thigh, knee, calf, ankle, biceps, forearm and wrist.

As part of the tests conducted for determining physical fitness properties handgrip, back and leg strength tests and vertical jump, flexibility, 30-second sit-up, 30-meter sprint, standing long jump, 20-meter dribbling and shuttle run tests were carried out.

In the sit and reach tests conducted for determining the lower back and hamstring flexibilities the subjects were asked to sit on the sit-and-reach table and without bending their knees to try to reach as much as possible with maximum body flexion towards their ankles at 90 degrees angle. In the 30-second sprint test, the subjects were asked to start at standing position and take the 30 meter distance as fast as possible. The times in these tests were recorded by means of electronic photocells (New Test 2000). In the sit-up test, number of sit-ups in 30 seconds were recorded.

Handgrip strength was measured with a Takkei brand (Grip Strength Dynamometer-T.K.K. 5101/Grip D; Made In Japan, Takei Scientific Instruments Co. Ltd.) hand dynamometer, while back and leg strengths were measured with back-leg dynamometer, vertical jump test for determining the explosive strength of the lower extremity were carried out with Takkei brand (Takei Physical Fitness Test Jumping) jump-meter, 20-meter dribbling tests with electronic photocells and standing long jump tests were measured with measuring tape.

Aerobic capacity value was calculated by means of a regression equation according to the maximum oxygen consumption (VO2max) age estimated by utilizing 20-meter shuttle running test and according to the running speed in the final lap [8,9].

Calculations: Data obtained from the tests were divided into two groups as those obtained from anthropometrical measurements and those obtained from performance measurements. In order to determine body fat percentages of the subjects, the body density equation of Durning & Womersley developed for children up to 17 years of age [9,10] and Siri's fat percentage equation [10,11] were utilized.

- Siri's Body Fat Percentage Equation [10,11]
- Body Fat Percentage =[(4.95/Body Density)-4.5) x 100
- Durnin & Womersley's Body Density Equation [10,11]
- Female Children;Body Density =1.1553-0.0643 x X
- Male Children;Body Density=1.1369-0.0632 x X
- LogX= (biceps + triceps + subscapular + subrailiac)

Statistical Analysis: Descriptive statistics of the age, height, weight, body mass index (BMI), anthropometrical measurements, body fat percentage findings and performance tests of male and female athletes were given as averages, standard deviation, minimum and maximum. In comparing the anthropometrical attributes and

performance tests of male and female athletes variance analysis and independent t-test were employed. SPSS 10.0.1 package program was used in the statistical analysis.

RESULTS AND DISCUSSION

The fact that the works in the literature focused on the anthropometrical and physical fitness attributes of young handball players of higher levels are limited makes it difficult to compare these with the handball performances of lower levels. The present study was conducted in order to examine some of the anthropometrical and physical fitness attributes of male and female handball players in teams competing in minors' category and to determine gender-specific differences. Physical attributes of the subjects who participated in the study are presented in Table 1.

In the height, weight, body fat percentage and BMI values of the male and female subjects, it was found out that, although they were from the same age group, the difference between the values were statistically significant ($P<0.05$, $P<0.001$). It was observed that the male players in this age group have a more dominant body structure. It is generally stated in publications concerning handball that heights of handball players are typically between 167 and 175 cm and their average weight is 66 kg [3, 12, 13]. However, recent studies reported 181.16 cm height and 81.59 kg weight [14] and 171.31 cm height and 67.55 kg weight [15]. Other data necessary to make comparison with other handball players from the same age are unavailable. However, the results can be compared with the results reported for adult high level handball players by considering link relatives. The difference between these studies and our study can be explained with the fact that the studies were made for adult age groups and that they belong to a different level than ours. In the study of Ibnziaten *et al.* the height and age averages of 11 year old handball players were reported to be 151.30 cm and 45.96 kg respectively [16]. Comparing these figures with what we obtained in our study exhibits that while the average heights for females are similar, their weights are lighter for about 2.84 kg and as for males, our subjects were about 13.09 cm higher and about 1.77 kg lighter than the averages values found in study of Ibnziaten *et al* [16].

While it was found out that the difference between the averages of the anthropometric measurement values of the subjects who participated in the study are statistically significant in height measurements ($p<0.001$), in skinfold measurements all differences between the averages of the parameters other than abdominal, thigh and calf skinfold are also significant ($p<0.05$, $p<0.001$), in bone diameter measurements the difference between the averages are significant ($P<0.001$, $p<0.05$), in circumference measurements the difference between the averages of chest, shoulder, back, abdominal, hip and thigh measurements are not significant ($p>0.05$), but in all other parameters the differences in the averages are significant ($p<0.001$, $p<0.05$) (Table 2).

In length measurements, it was observed that females have higher values in terms of fathom, hand and feet lengths. As for bone diameter values, while humerus and femur diameters were found out to be larger in male players, it was determined that females have larger biacromial and bitrochanteric diameters. In line with femur diameter width, in circumference measurements it was observed that knee circumferences in males are wider. It was also observed that knee, calf, ankle, biceps, forearm wrist and neck circumferences are smaller in males but other circumference measurements are similar.

It was reported that height and fathom lengths are very important in handball and being tall and having long fathom is a condition form for high performance and that there are players with fast ball throwing capabilities as if they gave long arm spans in relation with their heights [6]. Despite the fact that anthropometrical attributes such as height, body mass index, extremity circumferences and bone diameters provide interesting information, these attributes are mainly related with high performance [17]. Also, the magnitude of this relation varies due to different maturation levels, as it does with anthropometrical attributes affected with different forms of contribution [18]. Some anthropometrical attributes such as height may be the unreliable determinatives of future performance potential, due to the high variability in the adolescence period. For this reason, considering the anthropometrical attributes of child athletes as the exact determinatives of their anthropometrical profiles in the future will not be safe [17].

The differences found in the results obtained by the male and female handball players were found out to be statistically significant in handgrip strength ($p<0.05$), leg strength ($p<0.05$), vertical jump ($p<0.05$), 20-meter dribbling ($p<0.001$), 30-meter sprint $p<0.001$) and maxVO_2 ($p<0.05$) performance tests (Table 3).

In sports as handball and basketball handgrip strength has a considerable importance. All shots and throwing are finished with the wrist and the fingers. In their study, Visnapuu and Jurimae reported handgrip strength 1 1 years old handball players as 19.84 kg and

Table 1: Physical attributes of the male and female subjects and the differences between gender-specific averages.

Female (n=30) Average ± S.D.		Male (n=30) Average. ± S.D.	F Value	t Value	P Value
11.62±01.03	Age (years)	11.57±01.85	0.194	-6.843	0.662
151.68±06.18	Height (cm)	164.39±05.71	12.719	-2.182	0.001***
43.12±04.96	Weight (kg)	44.19±06.74	5.391	-2.414	0.024*
19.06±02.94	Body Fat (%)	20.87±05.41	8.615	1.606	0.005*
18.01±02.17	BMI (kg/m^2)	17.45±03.71	0.000	-2.635	0.996

*** p<0.001, * p<0.05

Table 2: Anthropometrical Measurement Values of Subjects.

Male (n=30) Average ± S.D.		Female (n=30) Average ± S.D.	t Value	F Value	P Value
		Length Measurements (cm)			
147.53±15.31	Fathom Length	154.03±07.67	-2.090	18.801	0.000***
15.19±01.38	Hand Length	16.28±00.88	-3.619	07.553	0.000***
21.82±02.18	Feet Length	22.27±00.74	-1.051	34.444	0.000***
		Skinfold Measurements (mm)			
13.35±05.88	Triceps	10.93±02.93	2.010	13.746	0.000***
09.59±04.65	Biceps	07.04±01.52	2.856	12.122	0.000***
10.75±05.89	S.Scapular	09.13±01.89	1.439	8.689	0.005***
11.70±06.75	S.Iliac	09.74±03.60	1.402	7.139	0.000***
13.54±07.93	Abdominal	14.62±04.97	-0.628	3.588	0.063
10.66±06.76	Midaxillar	09.10±03.01	1.154	6.845	0.011*
10.56±04.51	Forearm	08.58±01.99	2.190	10.841	0.002*
17.88±07.33	Thigh	19.16±05.27	-0.776	0.781	0.380
14.41±05.65	Calf	12.51±03.58	1.554	2.413	0.126
		Diameter Measurements (mm)			
05.75±00.68	Humerus	05.59±00.27	1.189	21.118	0.000***
08.84±00.80	Femur	08.73±00.48	0.606	14.194	0.000***
32.64±03.72	Biacromial	33.98±01.76	-1.782	13.229	0.000***
28.79±02.11	Bitrochanter	29.34±01.17	-1.265	5.639	0.021*
		Circumference Measurements (cm)			
85.51±05.33	Shoulder	92.19±06.13	-2.938	2.456	0.123
71.42±04.78	Chest	78.83±05.75	-3.260	1.205	0.277
64.10±03.97	Back	65.47±05.73	-0.655	3.821	0.055
69.88±05.09	Abdomen	75.80±06.49	-2.288	0.775	0.382
78.63±04.13	Hip	85.56±05.62	-2.743	0.988	0.324
37.20±03.63	Thigh	43.27±03.62	-4.621	0.091	0.764
32.38±01.83	Knee	32.28±01.96	0.119	4.903	0.031*
28.14±01.78	Calf	30.31±02.23	-2.285	4.050	0.046*
19.96±01.20	Ankle	20.58±01.52	-1.168	10.041	0.002*
20.57±01.87	Biceps	21.89±02.67	-1.647	5.185	0.026*
20.42±01.23	Forearm	20.80±01.72	-0.639	6.250	0.015*
14.30±00.82	Wrist	14.79±01.11	-1.429	7.536	0.008*
29.18±01.81	Neck	30.01±01.85	-1.341	9.117	0.004*

*** p<0.001, * p<0.05

Table-3: Values of the performance tests carried out in order to the determine the physical fitness of male and female subjects and gender-specific differences

Male (n=30) Average ± S.D.		Female (n=30) Average ± S.D.	t Value	F Value	P Value
29.42±04.85	Handgrip Strength (kg)	24.42±04.85	-0.563	7.651	0.008***
159.74±12.95	Stand. Long Jump (cm)	157.30±10.59	0.808	2.521	0.118
68.41±02.34	Back Strength (kg)	62.41±02.34	-1.911	1.327	0.254
69.17±06.21	Leg Strength (kg)	59.17±06.21	-1.478	4.082	0.048*
27.46±03.74	Flexibility (cm)	21.46±03.74	-3.609	1.934	0.170
47.38±04.18	Vertical Jump (cm)	41.38±04.18	1.889	4.894	0.031*
20.90±02.41	Sit-up	23.47±02.81	-3.794	1.368	0.247
05.11±00.78	20m. Dribbling (sec.)	04.34±00.32	4.969	14.284	0.000***
05.62±00.82	30m. Sprint (sec.)	05.45±00.41	0.992	18.422	0.000***
50.63±04.48	MaxVO2 (ml/kg/min)	47.55±05.14	1.784	3.759	0.023*

*** p<0.001, * p<0.05

added that when finger and hand surface parameters are longer and fingers are stronger, this value of handgrip strength can be more productive [19]. However, despite the fact that in our study the handgrip strength values of male players (29.42 kg) were found out to be higher than that of female players (24.42 kg), it was also found out that hand lengths of male players (15.29 cm) are smaller than that of female players (16.28 cm). Handgrip strength of the male handball players in of our study were found out bigger than the values obtained from the study of Visnapuu and Jurimae.

In our study, it was observed that the leg strength values of male players (69.17 kg) are higher than the same values of female players and that the difference in between them is statistically significant. Also the fact that male players' vertical jump values (47.38 cm) are higher than that of female players (41.38 cm) and the statistically significant difference between them may be interpreted that vertical jump attributes differ in line with leg strength attributes. In his study, Brown states that only increasing leg strength may not be enough in enhancing vertical jump skills, but also leg muscles have to be trained to react as fast as possible [20]. Vertical jump is a move that consist a complex series of movements. Success particularly depends on the strength of back muscles and lower extremity, flexibility and jumping technique. For this reason, determination of lower extremity strength and preparation of athletes' trainings in this orientation carry a significant importance in terms of performance enhancement [21,22]. Standing long jump is a reliable test for quickly evaluating the high muscle strength, which has a considerable importance in handball. In terms of standing long jump values, no difference was found between the male and female subjects participating to our study. Jumping distance is determined by a combined skill and depends on the explosive strength of leg muscles, flexibility of the muscles used in jumping and the technique of jumping itself. It is asserted that vertical and horizontal jumping comes from a common source [23]. Short distance sprinting speed is an important factor for the team performance in handball. A distance between 20 to 30 meters is often needed to be covered at maximum speed when going to offence from defense or after a turnover in order to prevent a fast break. In our study it was found out that the 30 meters sprinting test values of female players (5.45 seconds) are better than that of male players (5.62 seconds) and the difference is statistically significant ($p<0.001$). While Margques and Gonzalez-Badillo reported 30 meters sprint time as 4.47 seconds in their study [4], Gorostiaga *et al*. reported respectively 1.02 second and 2.46 seconds for 5 meter and 15 meter sprint times [24]. Since player typically play only for 25 to 30 minutes per match, a high aerobic capacity is not essential for handball players. Because players generally make short sprints of at least 20 meters in the matches, low levels of aerobic energy is consumed [25]. In another study the average VO2max values for male and female players were reported to be between 49.75 and 51.93 $ml.kg^{-1}.min^{-1}$ [26]. Based on this information and player substitution rules, it is considered that the maximum oxygen consumption performances of the subjects (for males 50.63 ml/kg/min, for females 47.55 ml/kg/min) will be adequate. It is reported that for a successful performance in handball height, hand length, explosive strength of the lower and upper extremity, running speed and aerobic capacity are highly important [27]. According to their functional and physical attributes, high level adult female athletes develop their maximum oxygen consumptions between 46 - 57 $ml.kg^{-1}.min$, their 30-meter sprint speeds between 4.4 - 5.5 seconds and their long jump distances between 165 - 230 cm (3, 28). Finally, it was also reported that the ball throwing speeds of high level adult female handball players vary between 57 to 83 km [3, 13, 29].

Knowing anthropometric and performance attributes of athletes provides coaches and several sports organizations with the preliminary information on the qualities of the athletes, which is important in determining suitable training models and selecting the athletes fit for a given branch of sports. Profiling works of male and female handball players of this age group is necessary for obtaining normative data. These findings may be added to the related international literature and the norms to be derived from them may help coaches and scouts in selecting young talents and determining the skills needed.

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