Sports University of Tirana
Faculty of Movement Sciences

SUMMARY

DOCTORATE THESIS

A comparison of anthropometric parameters between athletes of basketball, handball and volleyball

FIELD OF STUDY

SPORTS SCIENCES

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ABSTRACT

The anthropometry, composition and the body structure of the elite players of ball sports played by hand, were different based on the type of sport, selection criteria, hours of practice and the specific physiological demands during the game can explain the noticed differences. Surely, much more data is required to define the anthropometric profiles of international female athletes in the sports of basketball, volleyball and handball (Bayios, et al., 2006).

Summary of this study: The results showed the anthropometric measures of the professional players of the main three sports differ from one another while in the meantime there was no significant differences between the sports in the measures of the biceps and suprailliac skinfold.

Based on this study, sports have specific demands of anthropometric attritbutes which are specific for each player of the three sports: Basketball, volleyball and handball. Therefore, due to the diversity of the results, coaches have to create training programmes based on the sports specific demands and all the athletes in the field.

Keywords: body composition, weight, body height, BMI, perimeter

INTRODUCTION

Ball sports require full involvement, physical, technical, mental and tactical abilities.In between them, physial attributes of the athlete create significant effects in the skills of the athletes themselves and also the team tactics and performance. Considering that the athletes need to have physical abilites in order to meet the demands of the sports. In todays age, sport has become a cultural attraction in big and comple scale. It's aim is impressive and almost everyone around the world engages with some sportive activity in one way or another. Sport has spread massively around the globe.

Different research studies carried by experts of physical education and sports have emphasized the high importance of specific structures cojoinded with different sportive activities for the selection and the development of talents in sports for the best appearance in different levels of sportive competitions. There are a number of factors that determine the results of the athletes. Those factors are, physical, mental, technical and tactical. Between them, the anthropometric parametere and physical characteristics are of the biggest importance. The results depend on skills, training, motivation and other physiological factors. In Kosovo, continously have been made attempts to imporve the standards of our athletes for a long time and there has been achieved some visible success until now in this area.

Sucessful results in the international sports competitions requires a valuation of physical requirements of the athlete itself and the capacity of the team to meet those requests.

Optimal appearance nowadays requires a perfect combination of technical and tactical skills and also a high level of physical parameters. More favourable and sustainable results can be achieved by athletes that are better physically prepared in order to discover the importance of tests in the educational sports programmes. Nonetheless, the obvious decrease of effectiveness should be in the centre of attention of coaches.

According to Bayios, et al., (2006), anthropometry, body composition and structure of elite athletes in sports played by hand differ based on type of sport. Selection criteria, hours of training and specific physiologic sport demands can explain the differences identified in this study. Surely, more data is required to determine the anthropometric profiles of international athletes.

Concerns over the evaluation of physical preparedness and the decrease of effectiveness of basketball players initiated the study of Drinkwater et al., (2007) to carry the anthropometric tests and athletic-physical tests based on the age and year of recruitement. According to the above study some results of athletic-physic preparedness deterioarated in the course of an 8 year period. In addition, there was a slight increase in of the sprint

times and decrease of effecitvenes in the rund-and-back (medium in the Male National Team and obvious in the female National team).

Determination of the problem

1) Anthropometric charachteristics are known as an important contributor of athletic performance.
   However in Kosovo, unstandardized methods and deifinitions were used in the past to elaborate anthropometric characteristics of athletes and there is no information in regards tothese parameteres.
2) There was no single information regarding the specific anthropometric characteristics of the athletes in those disciplines.
3) Different indicators have been used in the past to evaluate the physical performance of athletes. However, noone has considered the rapports between standardized anthropometric measures and indicators of different parameters.

Aim

The aim of this study is the comparison of anthropometric measures of proffessional athletes of three different sports, Basketball, handball and volleyball.

Objectives

a) Determination of anthropometric profiles, body composition and body structure of elite athletes in the sports of basketabll, volleyball and handball.
b) Comparison of average results of anthropometric measures between the sports and
c) Discovering the possible differences in contrast with the competition of different sports.

Research hypothesis

1) There is no important correlation between variables of anthropometric measures and the chosen indicators of fat skinfolds measures and the perimeter of the carried measures (hypothesis Null)
2) There will be important differences in the anthropometric characteristics between the athletes of different disciplines (hypothesis Null).

Methodology

Methods

Forty-one (N= 41) professional male athletes (14 basketball players, 12 Handball players, 15 volleyball players) have voluntarily participated in this study. For each athlete anthropometric measures such as: weight, body height, supralillac, waist perimeter and BMI measures in each sports were carried. In addition, three additional perimeter measures were taken (Shoulders, thighs and pulp) and measures of fat skin folds (biceps, triceps, supralillac, sub scapular) of the athletes participating in this study.

The athletes appeared on the court at 8:00 am. The measures were taken for each athlete for Body Height (cm), body weight (kg) and waist perimeter. The body mass measures were carried using a gradual stadiometer up to 1 cm while the body weight was determined by electronic scale with accuracy up to 0.1kg.

BMI was calculated using the usual formula taken from the measures of weight and body height.

Participation in the study

Participation in the study was voluntarily and with the participants express permission from the group of athletes.

Exclusion criteria:

1) The athletes who did not practice regularly were excluded from the study.
2) Those athletes, who were injured during the practices or official games were excluded. Light injures were considered concussions and their variations while serious injures were consideret repeated injuries of the shoulders, fractures in foot joints, knees, broken bones, ligaments injuries etc.
3) Athletes with heavy respiratory illnesses and cardio-vascular diseases in the past were excluded from the study.

Anthropometric characteristics

Three indicators were measured for each athletes: height, body weight, body mass index (BMI) and waists perimeter.

Also measures for unique characteristics were selected because we believe that they affect in motoric ability and help in the athletes performance.

Perimeter of: shoulder, thigh and pulp.

Skinfold measurements of biceps, triceps, supralillac and sup scapular.

Anthropometry measurement instruments

Statistical analysis

For each athlete average values and standard deviation were calculated. General homogenity test of the data of each group showed that there is no considerable differences. An independent test was carried in order to calculate the differences between sports.

Analysis of variance (ANOVA) was carried into the tests in order to identify the differences for each sport. Having considerable differences in the average, it was proceeded with post hoc Tukey test which is used to determine comparison in analysis for

each athlete, which in the end determined the important differences. Significant level of $p \leq 0.05$ was accepted. All the analysis were carried using SPSS 17.0 application.

Results and interpretation

In table 1 given are the describing data of the three anthropometric measures (height, weight and waist perimeter) and the BMI calculation for the athletes conducted in this study. From the table it can be seen that average height of the athletes tested is 188.8 cm (Standard dev. 9.5) and minimal and maximal values (166 cm and 208 cm) while average weight of the athletes is 82.8 kg (standard dev. 13.8) and the minimal and maximal values (56 kg and 111 kg) and also the average value of the waist perimeter of the athletes is 83.8 cm (standard dev. 6.3) while the minimal and maximal values at (71.5 cm and 96 cm). Body mass averages of the tested athletes are 23 kg/m2 (standard dev. 2.4) while the minimal and maximal values at (17.9 kg/m2 and 28.8 kg/m2).

Table 1 Data describing anthropometric measures (average, min and max values and standard deviation)

	Description Data				
	N	Minimum	Maximum	Average	Standard deviation
Height	41	**166.0**	**208.0**	**188.769**	**9.5075**
Weight	**41**	**56.0**	**111.0**	**82.837**	**13.7658**
BMI	**41**	**17.9**	**28.8**	**23.039**	**2.4086**
Waist perimeter	41	**71.5**	**96.0**	**83.826**	**6.3491**

In table 2 the descriptive data of the three perimeter measurements (shoulders, thighs and pulp) and skinfold measurements of (biceps, tricepsm, suprailliac and subscapular) for the athletes participating in tihs study are given.

From the table it can be seen that the average value of the shoulder perimeter of the athletes is 30.2 cm (standard dev. 3.6) and the minimal and maximal values at (23cm and 37.5 cm), average thigh perimeter of the measured athletes is 54.9 cm (standard dev. 7.3) while the minimal and maximal values at (45 and 93 cm) while the average value of pulp perimeter is at 38.2 cm (standard dev. 2.7) while minimal and max values (34 and 45 cm).

In addition from the table it can be determined that average value of biceps skinfold is 4.6mm (stand dev 1.3) while minimal and maximal values (3mm and 10.5mm), average value of triceps skinfold of the athletes is 8.5mm (standard dev. 3.3) and the miniaml and maximal values at (3.6 and 20.6mm), average value of suprailliac skinfold of the athletes is 7.7 mm (standard dev. 3.3) and minimal and maximal values at (3 and 19mm) while the subcapular skinfold average value is 10.7mm (stand dev 2.6) while minimal and maximal values (6.4mm and 17.6 mm).

Table 2 Data describing the measurements of perimeters and skinfold (average, min. Value , max. Value and standard dev.)

	Descriptive data				
	N	Minimum	Maximum	Average	Standard Deviation
Shoulder perimeter	**41**	**23.0**	**37.5**	**30.244**	**3.6067**
Thigh perimeter	**41**	**45.0**	**91.3**	**54.910**	**7.3158**
Pulp perimeter	**41**	**34.0**	**45.0**	**38.273**	**2.6739**
Biceps (skinfold)	**41**	**3.0**	**10.5**	**4.622**	**1.3571**
Triceps (skinfold)	**41**	**3.6**	**20.6**	**8.541**	**3.3033**
Suprailliac (skinfold)	**41**	**3.0**	**19.0**	**7.734**	**3.3591**
Subscapular (skinfold)	**41**	**6.4**	**17.6**	**10.741**	**2.5684**

The comparison of height (table 3) between basketball and handball athletes is p=0.000 (avg diff = 16.66; Std Error = 2.77), between basketball and volleyball is p=0.000 (avg diff = 11.75; Std. Error = 2.63), between handball and volleyball p=0.070 (avg diff = -4.92; std error = 2.63).

Comparison of weight between basketball and handball is p=0.000 (avg diff. = 23.72; Std. error =3.54), basketball and volleyball p=0.000 (avg diff = 20.07; std error 3.40) and between handball and volleyball p=0.309 (avg diff.==3.65; std error=3.54),

BMI comparison between basketball and handball is p=0.003 (avg diff=2.62; std error=0.82), between basketball and volleyball p=0.002 (avg diff =2.59; std error =0.79) while between handball and volleyball p=0.0967 (avg diff = -0.35; std Error = 0.83).

Comparison between waist perimeter between basketball and handball p= 0.002 (Avg diff= 7.57; Std error= 2.22), basketball and volleyball p= 0.002 (Avg diff= 7.3; Std error= 2.14), handball and volleyball p= 0.889 (Avg diff= -2.74; Std error= 2.14).

Table 3. Comparison "LSD post hoc" of measures of height, weight, BMI and waist perimeter between sports of basketball, handball and volleyball.

Krahasim i shumëfishtë

LSD

Varur variable	(I) Sport	(J) Sport	Average Diferen (I-J)	Std error.	Sig.	95% Confidence Interval	
						Lower Level	Upper Level
Height	Basketball	Basketball					
		Handball	**16.6667***	**2.7726**	**.000**	**11.044**	**22.290**
		Volleyball	**11.7500***	**2.6304**	**.000**	**6.415**	**17.085**
	Handball	Basketball	**-16.6667***	**2.7726**	**.000**	**-22.290**	**-11.044**
		Handball					
		Volleyball	**-4.9167**	**2.6304**	**.070**	**-10.251**	**.418**
	Volleyball	Basketball	**-11.7500***	**2.6304**	**.000**	**-17.085**	**-6.415**
		Handball	**4.9167**	**2.6304**	**.070**	**-.418**	**10.251**
		Volleyball					
Weight	Basketball	Basketball					
		Handball	**23.7202***	**3.5408**	**.000**	**16.546**	**30.895**
		Volleyball	**20.0714***	**3.4019**	**.000**	**13.179**	**26.964**
	Handball	Basketball	**-23.7202***	**3.5408**	**.000**	**-30.895**	**-16.546**
		Handball					
		Volleyball	**-3.6488**	**3.5408**	**.309**	**-10.823**	**3.525**
	Volleyball	Basketball	**-20.0714***	**3.4019**	**.000**	**-26.964**	**-13.179**
		Handball	**3.6488**	**3.5408**	**.309**	**-3.525**	**10.823**
		Volleyball					
BMI	Basketball	Basketball					
		Handball	**2.6238***	**.8294**	**.003**	**.943**	**4.304**
		Volleyball	**2.5893***	**.7969**	**.002**	**.975**	**4.204**
	Handball	Basketball	**-2.6238***	**.8294**	**.003**	**-4.304**	**-.943**
		Handball					
		Volleyball	**-.0345**	**.8294**	**.967**	**-1.715**	**1.646**
	Volleyball	Basketball	**-2.5893***	**.7969**	**.002**	**-4.204**	**-.975**

		Handball	**.0345**	**.8294**	**.967**	**-1.646**	**1.715**
		Volleyball					
Waist Perimeter	Basketball	Basketball					
		Handball	**7.5750***	**2.2233**	**.002**	**3.061**	**12.089**
		Volleyball	**7.3012***	**2.1424**	**.002**	**2.952**	**11.651**
	Handball	Basketball	**-7.5750***	**2.2233**	**.002**	**-12.089**	**-3.061**
		Handball					
		Volleyball	**-.2738**	**2.1424**	**.899**	**-4.623**	**4.076**
	Volleyball	Basketball	**-7.3012***	**2.1424**	**.002**	**-11.651**	**-2.952**
		Handball	**.2738**	**2.1424**	**.899**	**-4.076**	**4.623**
		Volleyball					

*. Average difference is significant on level 0.05 .

In table 4 are given the comparison data between the measurements of the perimeter of shoulder, thighs and pulps between the sports of (basketball, handball and volleyball). The comparison of the shoulder perimeter is p= 0.000 (F= 16.263), thigh p= 0.045 (F= 3.376), IMT p= 0.003 (F= 6.948), and pulp p= 0.002 (F= 7.657).

Table 4. Comparison of measurements of the perimeter of shoulder, thigh and the pulp between the sports of basketball, handball and volleyball.

ANOVA

		Amount of squares	df	Average of squares	F	Sig.
Shoulder perimeter	Between groups	**239.980**	**2**	**119.990**	**16.263**	**.000**
	Inside groups	**280.361**	**38**	**7.378**		
	Total	**520.341**	**40**			
Thigh perimeter	Between Groups	**323.024**	**2**	**161.512**	**3.376**	**.045**
	Inside groups	**1817.832**	**38**	**47.838**		
	Total	**2140.856**	**40**			
Pulp perimeter	Between groups	**82.143**	**2**	**41.071**	**7.657**	**.002**
	Inside groups	**203.838**	**38**	**5.364**		
	Total	**285.980**	**40**			

In Table 5 are given the data for the deep comparison of the measures of the perimeters of shoulder, thigh and pulp between the sports of (basketball, handball and volleyball)

The comparison of the shoulder perimeter between the sport of basketball and handball is p= 0.000 (Avg diff= 5.41; Std error= 1.07), basketball and volleyball is p= 0.000 (Avg diff= 4.7; Std error= 1.00),handball and volleyball p= 0.559 (Avg diff= -0.62; Std error= 1.05).

Comparison of the thigh perimeter between the sport of basketball and handball is p= 0.038 (Avg diff= 5.8; Std error= 2.72), basketball and volleyball is p= 0.026 (Avg diff= 5.97; Std error= 2.57), handball and volleyball p= 0.963 (Avg diff= 0.16; Std error= 2.67).

Comparison of the pulp perimeter between basketball and handball p= 0.004 (Avg diff= 2.77; Std error= 0.91), basketball and volleyball p= 0.001 (Avg diff= 3.12; Std error= 0.86), and handball and volleyball p= 0.692 (Avg diff= 0.36; Std error= 0.89).

Multiple comparison

LSD

Varur Variable	(I) Sport	(J) Sport	Avg difference.	Std. Error	Sig.	95% Confidence interval	
						Low Level	Upper Level
Shoulder perimeter	Basketball	Basketball					
		Handball	**5.4190***	**1.0686**	**.000**	**3.256**	**7.582**
		Volleyball	**4.7990***	**1.0094**	**.000**	**2.756**	**6.842**
	Handball	Basketball	**-5.4190***	**1.0686**	**.000**	**-7.582**	**-3.256**
		Handball					
		Volleyball	**-.6200**	**1.0520**	**.559**	**-2.750**	**1.510**
	Volleyball	Basketball	**-4.7990***	**1.0094**	**.000**	**-6.842**	**-2.756**
		Handball	**.6200**	**1.0520**	**.559**	**-1.510**	**2.750**
		Volleyball					
Thigh perimeter	Basketball	Basketball					
		Handball	**5.8488***	**2.7209**	**.038**	**.341**	**11.357**
		Volleyball	**5.9738***	**2.5702**	**.026**	**.771**	**11.177**
	Handball	Basketball	**-5.8488***	**2.7209**	**.038**	**-11.357**	**-.341**
		Handball					
		Volleyball	**.1250**	**2.6787**	**.963**	**-5.298**	**5.548**
	Volleyball	Basketball	**-5.9738***	**2.5702**	**.026**	**-11.177**	**-.771**
		Handball	**-.1250**	**2.6787**	**.963**	**-5.548**	**5.298**
		Volleyball					

Pulp perimeter	Basketball	Basketball					
		Handball	**2.7702***	**.9111**	**.004**	**.926**	**4.615**
		Volleyball	**3.1286***	**.8607**	**.001**	**1.386**	**4.871**
	Handball	Basketball	**-2.7702***	**.9111**	**.004**	**-4.615**	**-.926**
		Handball					
		Volleyball	**.3583**	**.8970**	**.692**	**-1.458**	**2.174**
	Volleyball	Basketball	**-3.1286***	**.8607**	**.001**	**-4.871**	**-1.386**
		Handball	**-.3583**	**.8970**	**.692**	**-2.174**	**1.458**
		Volleyball					

*. Average significant difference on level 0.05 .

In table 6 are given the data for comparison between the measurements of skinfold between the three disciplines of sports, basketball, handball and volleyball Comparison for biceps (skinfold) është p= 0.086 (F= 2.621), triceps (skinfold) është p= 0.015 (F= 4.737), suprailliac (skinfold) është p= 0.130 (F= 2.156), subscapular (skinfold) është p= 0.002 (F= 7.419).

Tabela 6. Krahasimi i matjeve të plikave ndërmjet Sportve të sporteve Basketball, Handball dhe Volleyball.

ANOVA

		Shuma e katrorëve	df	Mesatarja e katrorëve	F	Sig.
Biceps (skinfold)	Ndërmjet Grupeve	**8.932**	**2**	**4.466**	**2.621**	**.086**
	Brenda Grupeve	**64.738**	**38**	**1.704**		
	Total	**73.670**	**40**			
Triceps (skinfold)	Ndërmjet Grupeve	**87.109**	**2**	**43.555**	**4.737**	**.015**
	Brenda Grupeve	**349.370**	**38**	**9.194**		
	Total	**436.480**	**40**			

Suprailliac (skinfold)	Ndërmjet Grupeve	**45.997**	**2**	**22.999**	**2.156**	**.130**
	Brenda Grupeve	**405.335**	**38**	**10.667**		
	Total	**451.332**	**40**			
Subscapular (skinfold)	Ndërmjet Grupeve	**74.097**	**2**	**37.049**	**7.419**	**.002**
	Brenda Grupeve	**189.762**	**38**	**4.994**		
	Total	**263.860**	**40**			

Table 7 contains the data for the detailed comparison of the measurements between the sports of basketball, handball and volleyball.

Comparison of biceps (skinfold) between basketball and handball is p= 0.573 (Avg diff= 0.29; Std error= 0.51), basketball and volleyball p= 0.033 (Avg diff= 1.07; Std error= 0.48), handball and volleyball p= 0.130 (Avg diff= 0.78; Std error= 0.50).

Comparison for triceps (skinfold) between basketball and handball p= 0.004 (Avg diff= 3.60; Std error= 1.19), basketball and volleyball është p= 0.055 (Avg diff= 2.23; Std error= 1.12), handball and volleyball p= 0.250 (Avg diff= -1.37; Std error= 1.17).

Comparison for suprailliac (skinfold) between basketball and handball p= 0.596 (Avg diff= 0.68; Std error= 1.28), basketball and volleyball p= 0.051 (Avg diff= 2.44; Std error= 1.21), handball and volleyball p= 0.173 (Avg diff= 1.75; Std error= 1.26).

Comparison for supscapular (skinfold) between basketball and handball is p= 0.003 (Avg diff= 2.76; Std error= 0.87), basketball and volleyball p= 0.001 (Avg diff= 2.88; Std error= 0.83), handball and volleyball p= 0.889 (Avg diff= 0.12; Std error= 0.86).

Table 7. Comparison “LSD post hoc” of the skinfold measurements between the sports of basketball, handball and volleyball.

Multiple comparison

LSD

Varur Variable	(I) Sport	(J) Sport	Difference avg. (I-J)	Std. Error	Sig.	95% Confidence interval	
						Under Level	Over level
Biceps (skinfold)	Basketball	Basketball					
		Handball	.2917	.5135	.573	-.748	1.331
		Volleyball	1.0733*	.4850	.033	.091	2.055
	Handball	Basketball	-.2917	.5135	.573	-1.331	.748
		Handball					
		Volleyball	.7817	.5055	.130	-.242	1.805
	Volleyball	Basketball	-1.0733*	.4850	.033	-2.055	-.091
		Handball	-.7817	.5055	.130	-1.805	.242
		Volleyball					
Triceps (skinfold)	Basketball	Basketball					
		Handball	3.6060*	1.1928	.004	1.191	6.021
		Volleyball	2.2343	1.1268	.055	-.047	4.515
	Handball	Basketball	-3.6060*	1.1928	.004	-6.021	-1.191
		Handball					
		Volleyball	-1.3717	1.1743	.250	-3.749	1.006
	Volleyball	Basketball	-2.2343	1.1268	.055	-4.515	.047
		Handball	1.3717	1.1743	.250	-1.006	3.749
		Volleyball					
Suprailliac (skinfold)	Basketball	Basketball					
		Handball	.6869	1.2848	.596	-1.914	3.288
		Volleyball	2.4419	1.2137	.051	-.015	4.899
	Handball	Basketball	-.6869	1.2848	.596	-3.288	1.914
		Handball					
		Volleyball	1.7550	1.2649	.173	-.806	4.316
	Volleyball	Basketball	-2.4419	1.2137	.051	-4.899	.015
		Handball	-1.7550	1.2649	.173	-4.316	.806
		Volleyball					
Supscapular (skinfold)	Basketball	Basketball					
		Handball	2.7655*	.8791	.003	.986	4.545
		Volleyball	2.8871*	.8304	.001	1.206	4.568
	Handball	Basketball	-2.7655*	.8791	.003	-4.545	-.986
		Handball					
		Volleyball	.1217	.8655	.889	-1.630	1.874

	Volleyball	Basketball	**-2.8871***	**.8304**	**.001**	**-4.568**	**-1.206**
		Handball	**-.1217**	**.8655**	**.889**	**-1.874**	**1.630**
		Volleyball					

*. Average difference is significant on level 0.05 .

Discussions

The aim of this study is the comparison of anthropometric measurements of professional athletes in three different sports, that of basketball, handball and volleyball. From this study we can conclude that the measurements of weight, height, BMI, waist perimeter and the perimeters of the three main muscular areas if basketball players were considerably higher (significant $p \leq 0.05$) than that of athletes of volleyball and that there is no significant differences in the measurement of skinfold of biceps and suprailliac.

In addition to the above, basketball players were considerably heavier than volleyball players (+20 kg; $p \leq 0.05$) and of handball (+23.7 kg; $p \leq 0.05$while the volleyball and handball (+3.6 kg; $p > 0.05$).

Basketball players were also considerably higher than volleyball players (+11.8 cm; $p \leq 0.05$) and handball players (+16.6 cm; $p \leq 0.05$) while volleyball vs handball (+4.9 cm; $p > 0.05$).

BMI of the basketball players was higher than volleyball (+2.6 kg/m2; $p \leq 0.05$) and handball players (+2.6 kg/m2; $p \leq 0.05$), while volleybal players vs handball players (+0.03 kg/m2; $p > 0.05$) while the waist perimeter was higher than that of volleyball players (+7.3 cm; $p \leq 0.05$) and handball players (+7.6 cm; $p \leq 0.05$) differences between volleyball and handball (+0.3 cm; $p > 0.05$).
Additionally, the basketball players had higher perimeter of the three main muscular groups.

Shoulder perimeter – basketball players have higher values than volleyball (+4.7 ; $p \leq 0.05$) and handball (+5.4; $p \leq 0.05$), vhile volleyballers vs handballers (+0.6 ; $p > 0.05$).

Thigh perimeter- basketball players have higher values than volleyball players (+6 ; $p \leq 0.05$) and handball (+5.8; $p \leq 0.05$), while volleyballers vs handballers (-0.1 ; $p > 0.05$).

Pulp perimeter – Basketball players have higher values than that of volleyball players (+3.1 ; $p \leq 0.05$) while handballers (+2.8; $p \leq 0.05$), while volleyballers vs handballers (-0.4 ; $p > 0.05$).

There are no significant differences betwee the sports in the measurements of skinfold of biceps and supralillac.

While in the triceps skinfold measurements: basketball players had higher values than volleyball (+2.2 mm; $p \leq 0.05$) and handball (+3.6 mm; $p \leq 0.05$), while volleyball and handball players (1.3mm; $p > 0.05$) and the subscular skinfold: basketball players have higher values than volleyball (+2.9 mm; $p \leq 0.05$) and handball (+2.8 mm; $p \leq 0.05$) while volleyball and handball (-0.1mm; $p > 0.05$).

According to Bayios, et al., (2006) the anthropometry, composition and body structure of elite players in hand sports differ based on type of sports. Selection criteria, hours of training and specific physiological demands of the sports during the game can explain the found differences in this study. Surely, more data is required to determine the anthropometric profiles of international athletes.

Hoare 2000 carried anthropometric and physical attributes measurements of 125 male players and 123 female of basketball game and under the age of 16. The better players differed themselves from the rest of the field based on their anthropometric and physiologic characteristics. The differences were true in both male and female measurements.

Anthropometric characteristics can affect the procedures for the selection of young basketball players but nonetheless the determiners of success are a bunch of factors. (Hoare 2006).

Results of the discriminatory analysis (Trninic et al,. 1999) show that anthropometric status makes the difference between the basketball players based on game positions. So that determines roles, duties and the job that every player carries in the playing court. These duties are expressed by them in the quality of indicators of game efficiency (offensive and defending of the board from returned balls and also the difference in the blocking of opponents shots of center position players an the defenders from one side and the offensive players in the other; they also help in differentiating between defenders na defenders and center players; in the same time when when positions of three point shots differ the offenders and guards from the cetner players).

Based on the study of Bayios, et al., (2006), it results that volleyball players were the tallest ($P<0.001$) between the three other groups and had the lowest values of body fat ($P<0.001$) and their body structure was characterized by a balanced endomorphism. (3.4-2.7-2.9).

Basketball players were taller than ($P<0.001$) and slimmer than ($P<0.001$) handball players with a body structure characterized as mesomorph-endomorphic (3.7-3.3 2.4). Handball players were shortes of the group ($P<0.01$),, had the highest level of body fat percentage($P<0.001$), and their body structure was characterized as mesomorph-endomorph (4.2-4.7-1.8). In comparison to their colleagues of category A2, players of A1 were taller ($P<0.001$), and heavier ($P<0.01$), but in the same time skinnier and with homogenity in their body structure characteristics ($P<0.05$).

Anthropometry, composition and body structure of elite players in hand sports differ based on type of sports. Selection criteria, hours of training and specific physiological demands of the sports during the game can explain the found differences in this study. Surely, more data is required to determine the anthropometric profiles of international female athletes for basketball, handball and volleybal (Bayios et al., 2006). Succesful appearances require explosive force of legs and shoulders, speed in sprint and kinestetic feelings in ball control (Sibila et al., 1997). In the other hand, for a role model player of handball player, have to be considered important the stature length, spread shoulders , hand extension (Sibila et al., 1997; Sirhoj et al., 2002; Scoufas et al., 2003). Such a

anthropometric profile plays a supporting role in helping the players to compete in the current conditions (Sirhoj et al., 2002). Long upper limbs contribute in the speed increase (Fleising et al., 1999) and hand extension has effect on motoric abilities such as dribling, passing, catching and stopping the ball (Scoufas et al., 2003).

Physical characteristics of a player are important factors in determining if he/she will achieve a high level in the specific sport that he or she chose (Sallet et al., 2005). Sallet and colleagues (2005) in their work didn't find any important statistical differences in the characteristics between between basketball players of two different divisions in France. Schiltz et al., (2009) have demonstrated also that relative isokinetic indicators of professional basketball players were similar with those of young basketball players. The results of this study show that physical characteristic and appearance in tests in both divisions, first and second are statistically similar except for jumping in countermovement and 10 m sprints. These results show that basketball players of professional level have similar physical attributes.

Height and body mass of basketball players is one of the factors that determine and evaluate their position in the game (Drinkwater etc. 2008). In this study, gurds were considerably shorter than forwards and centers ($p \leq 0.05$). This conclusion was reached in many more studies (Bradic et al., 2009; Ostojic et al, 2006; Sallet et al, 2005).

Body composition is also another important aspect in the preparation of sportive teams, like the excess fat tissue that acts as a dead mass during sportive activities where body mass has to continously react against gravity (Reilly et al,. 2000). In reality, in this study, centers had considerably higher body mass compared to forwards and guards.

Summary and recommendations

As a summary in this study, the results here have shown that anthropometric measures of the professional athletes of the three main sports have differences between them, in the meantime no significant differences were identified between sports in the measures of the skinfold of biceps and suprailliac. Based on this study, sports have specific demands of anthropometric attritbutes which are specific for each player of the three sports: Basketball, volleyball and handball. Therefore, due to the diversity of the results, coaches have to create training programmes based on the sports specific demands and each of the athletes in the field.

Specific anthopometric characteristics differ mainly at the professional male basketball players. These results suggest that common physical and anthropometric characteristics have to be considered in every selection test of the different sports. However, selection should not be solely limited to anthropometric data especially in the young generations where maturity has to be considered. Full measurement of physical characteristics in combination with other specific game tests of the specific sport in all three of them (aiming precision, passing ability, slalom dribbles) have to be also included in the selection procedure.

The ability to move with the ball, the ability to change the speed in turns, ability to aim the accuracy to score, the ability to move in a triangle scheme (defense move) are very important parameters and have to be considered carefully when the players are tested.

The evolution of standard test that simulate real game situations together with the evaluation of unique skills of physical preparation and anthropometric characteristics are decision making for the future of one team.

The challenge is clear for the coaches, to develop unqiue skills for different tests of physical preparation combined with anthopometric characteristics in order to enable more exact measurements of skills and requirements of different positions during the game.

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