

Full Length Research

Comparison of Anthropometric and Somatotype characteristics of amateur and professional soccer goalkeepers in Trabzon

¹Prof. Dr. Vedat Ayan, ²Yalçın İnan, and ³Prof. Dr. Selami Yüksek

¹Trabzon University Sport Sciences Faculties, Trabzon, Turkey. Email: vayan61@gmail.com; Tel.: +905052381349

²Anadolu İmam Hatip Lisesi, Trabzon, Turkey. Email: k.trainer@hotmail.com; Tel.: +905054873881

³Trabzon University Sport Sciences Faculties, Trabzon, Turkey. Email: syuksekgazi.edu.tr; Tel.: 05052520073

Accepted 27th February, 2020

The purpose of this study was to determine and compare the somatotype differences between the junior goalkeepers playing for the amateur and professional soccer teams in the U-13 League of Trabzon. Sixty volunteer goalkeepers, including 30 professional and 30 amateur players from professional and amateur teams in the city of Trabzon, participated in this study. For somatotype calculations, ten anthropometric variables including height, mass, selected diameters, girths and skinfold thickness were measured. The Heath-Carter somatotype method was used to determine somatotypes. So descriptive statistics and Data frequency values were also evaluated. The Independent-Samples T-test was used to find out statistically significant differences. While the professional goalkeepers aged between 13,06±1,73 had a mean height of 164.33±13.62 cm and a mean weight of 54.05±14.88 kg; the amateur goalkeepers aged between 13,37±1,71 had a mean height of 159.37±12.39 cm and a mean body mass of 53.94±14.80 kg. No statistically significant difference was found between the mean heights, weights, subscapular skinfold thicknesses, the girths of biceps and calf, the diameters of elbow and knee ($p>0,05$). Statistically significant difference was found in favor of amateur goalkeepers for the following measurements: biceps, triceps, supra-iliac skinfold thicknesses ($p<0,05$). While endomorph ($p<0,05$) and mesomorph ($p<0,01$) values were significant for amateurs, a significant difference was in ectomorph values ($p<0,01$) for professionals. In conclusion, it was found that the goalkeepers playing for the professional teams were 2-4-4 (mesomorph-ectomorphs), while the goalkeepers playing for the amateur teams were 3-5-3 (balanced mesomorphs). According to the somatotypes, it is thought that goalkeepers playing for the professional soccer teams had a better physical structure than those playing for the amateur teams.

Keywords: Anthropometry, Soccer, Goalkeeper, Somatotype

INTRODUCTION

Somatotype refers to a taxonomy developed for categorizing the human physique and appraising body shape. In order to increase the performances of junior soccer players, more information is needed on their somatotypes. An understanding of the anthropometric and physiological profiles of junior athletes may be important for talent identification, planning special training programmes, accurate distribution of resources within a team and selection of sports (Gualdi-Russo and Zaccagni, 2001).

An athlete's body shape or anthropometric characteristics can influence his/her level of performance, since physique is closely related with how the

physiological capacity is used. If an athlete's physique is not suitable for a certain sport, it will be practically impossible to reach the desired level of performance. Physical structure is one of the indicators of high performance; and it can positively influence an athlete's performance together with the other performance indicators like strength, robustness, flexibility, speed, endurance and agility (Açıkada and Ergen, 1990).

Technical and tactical capabilities, anthropometric characteristics and individual physical performances are crucial for the success of soccer teams, as it is the case with the other sports (Hakinken K, 1992 and Laessens et

al., 1987).

This study aimed to determine and compare the somatotypes of goalkeepers playing for the professional and amateur soccer teams in Trabzon.

MATERIALS AND METHOD

60 volunteers, 30 amateur and 30 professional goalkeepers playing for the soccer teams in the U-13 category, participated in this study. Parental permission was obtained for the measurements in the study. Ten anthropometric variables including height, body mass, selected diameters, girths and skinfold thickness were measured in order to determine the somatotypes of goalkeepers. These measurements were made in line with the techniques described by "International Biological Programme (IBP)" (Lohman et al., 1988) and "International Society for the Advancement of Kinanthropometry (ISAK)" (Ross and Marfell-Jones, 1991). The measurements were taken in accordance with the principles of Helsinki Declaration. The Heath-Carter method was used to determine the somatotypes of the goalkeepers (Carter and Heath, 1990).

Heath-Carter Somatotype Formula

$$\text{Endomorphy} = -0.7182 + 0.1451 * x - 0.00068 * x^2 + 0.0000014 * x^3$$

(x = "triceps" skinfold + "supraspinale" skinfold + "subscapular" skinfold)

Height Correction Formula = $x * 170.18 / \text{height (cm)}$

Mesomorphy = $[0.858 + 0.601 * \text{humerus breadth} - \text{"bicondylar humerus"} \text{ (cm)} + 0.601 * \text{femur breadth} - \text{"bicondylar femur"} \text{ (cm)} + 0.188 * \text{upper arm girth} \text{ (cm)} + 0.161 * \text{calf girth} \text{ (cm)}] - [\text{height (m)} * 0.131] + 4.50$

Ectomorphy = $(\text{Mass-height ratio}) * 0.732 - 28.58$

(Mass-height ratio = $\text{Height} / \sqrt{\text{Mass}}$)

X and Y coordinates in the Somatochart were calculated as follows:

$x = \text{Ectomorphy} - \text{Endomorphy}$

$y = 2 * \text{Mesomorphy} - (\text{Endomorphy} + \text{Ectomorphy})$

Somatotypes were plotted on a somatochart by calculating values of X and Y-axis. After the calculation, x and y coordinates were marked on the somatochart to determine the somatotypes of goalkeepers.

Statistical Analyses

Obtained data were analyzed by using SPSS 17,0 statistics software. Descriptive statistics and frequency distributions of data were examined. Independent samples t-test was applied in order to evaluate the significance levels of differences between the goalkeepers playing for the professional and amateur soccer teams, at the level of $p < 0,05$ and $p < 0.01$.

RESULTS

Table 1 shows the descriptive statistical values regarding the professional and amateur goalkeepers, while table 2

indicates the data derived from Independent-Samples T-test and table 3 presents x and y values of the somatochart.

Table 1 shows the statistical results regarding the anthropometric measurements of the goalkeepers playing for the professional and amateur teams.

Our Independent Samples T-test results show a significant difference ($p < 0,05$) in favour of amateur goalkeepers with regards to triceps, suprailiac and calf skinfold thicknesses, when compared according to the athletic levels. After the evaluation of results, no significant difference ($p > 0,05$) was found between girth and breadth measurements of two groups. Somatotype evaluations revealed a significant difference in favour of amateurs for endomorph ($p < 0,05$) and mesomorph ($p < 0,01$) values and a significant difference in ectomorph values ($p < 0,01$) in favour of professionals.

Table 3 shows the somatotype component values (based on athletic performance levels) derived from data used for our study.

Figure 1 presents the distribution of mean somatotypes on the somatochart of goalkeepers playing for amateur and professional soccer teams.

Figure 2 shows the mean somatotypes of the goalkeepers playing for the professional and amateur soccer teams.

DISCUSSION

Achieving success is the main purpose of all sports. Growing scientific literature on sports helps to increase the performance levels of athletes in our country. Several studies revealed that athletic body shapes vary by sport and even by the different categories of the same sport. Findings on body composition are of great importance in terms of guiding young people in sports, training junior athletes and increasing the performance of professional athletes. Thus, it is very important to determine morphological and physiological characteristics of the athletes (Carter and Heath, 1990; Heyward and Stolarczyk, 1996; Ross and Marfell-Jones, 1991; Zorba and Ziyagil, 1995).

Measurements of height and weight

Our study revealed that while the professional junior goalkeepers had a mean height of $164,33 \pm 13,62$ cm and mean weight of $54,05 \pm 14,88$ kg; the junior amateur goalkeepers had a mean height of $159,37 \pm 12,39$ cm and mean weight of $53,94 \pm 14,80$ kg. No statistically significant difference was found between heights and weights of the goalkeepers playing for the amateur and professional soccer teams (Table 1).

Ayan et al. (2011) found the mean length average of $132,1 \pm 5,37$ cm, body weight average was $28,87 \pm 3,59$ kg. on his investigation of somatotype and performance characteristics for the boys' football branch (Ayan et al., 2011). The results obtained in their study and the results obtained in our study do not show similarity with each

Table 1: Descriptive Statistical Data Related to the Goalkeepers Playing for Professional and Amateur Soccer Teams.

Categories	Level	N	Min.	Max.	Mean.	Std.
Age (years)	Professional	30	11.0	16.0	13.60	1.73
	Amateur	30	11.0	16.0	13.37	1.71
Weight (kg)	Professional	30	30.0	83.0	54.05	14.88
	Amateur	30	33.0	93.0	53.94	14.80
Height (cm)	Professional	30	142	190	164.33	13.62
	Amateur	30	142	184	159.37	12.39
Triceps sk (mm)	Professional	30	4,8	16.6	8.82	2.94
	Amateur	30	5.4	23.6	11.12	4.21
Subscapular sk (mm)	Professional	30	3.6	10.6	6.78	1.74
	Amateur	30	4.0	26.0	8.46	4.50
Suprailiac sk (mm)	Professional	30	2.8	9.6	5.24	1.85
	Amateur	30	3.0	21.2	7.27	4.98
Calf sk (mm)	Professional	30	2.3	18.2	10.44	3.98
	Amateur	30	5.4	36.4	14.21	7.61
Biceps girth (cm)	Professional	30	20.0	30.4	24.59	3.26
	Amateur	30	19.0	32.5	25.58	3.38
Calf Girth (cm)	Professional	30	25.0	40.5	32.65	3.73
	Amateur	30	26.5	42.1	33.95	4.07
Humerus breadth (cm)	Professional	30	5.7	7.6	6.56	0.52
	Amateur	30	5.4	7.9	6.58	0.59
Femur breadth (cm)	Professional	30	8.1	11.1	9.78	0.72
	Amateur	30	8.6	11.8	9.99	0.84
Endomorph	Professional	30	1	4	2.10	0.92
	Amateur	30	1	6	2.77	1.40
Mesomorph	Professional	30	2	6	3.90	1.06
	Amateur	30	3	8	5.13	1.30
Ectomorph	Professional	30	2	6	3.63	1.09
	Amateur	30	0	5	2.77	1.30

other. The differences in the results of these two studies are thought to stem from the differences in the athletes' growth and development characteristics.

Apti A. (2010) also carried out a research with the participation of 122 soccer players aged between 10-18 and found that they had a mean height of $161,77 \pm 19,36$ cm and mean body mass of $54,30 \pm 13,94$. The average height value in the study is not similar to that in our study. The difference in the mean height values of these two studies is thought to stem from the differences in the athletes' growth and development characteristics.

Measurements of skinfold thickness

As a result of our research, following skinfold thickness values were found: Triceps SK $8,8 \pm 2,9$ mm, Subscapular SK $6,7 \pm 1,7$ mm, Suprailiac SK $5,2 \pm 1,8$ mm, Calf SK $10,4 \pm 3,9$ mm for professional goalkeepers; and Triceps SK $11,1 \pm 4,2$ mm, Subscapular SK $8,4 \pm 4,5$ mm, Suprailiac SK $7,2 \pm 4,9$ mm, Calf SK $14,2 \pm 7,6$ mm for amateur goalkeepers (Table 1). These findings revealed a statistically significant difference ($p < 0,05$) in triceps sk, suprailiac sk and calf sk values in favour of goalkeepers

playing for amateur soccer teams. No significant difference in subscapular sk was found between groups ($p > 0,05$) (Table 2).

Ayan et al. (2011) found triceps dkk $8,2 \pm 1,6$ mm, subscapula dkk $6,2 \pm 1,2$ mm, suprailiac dkk $9,3 \pm 1,6$ mm and calf fdkk $14,4 \pm 4,0$ mm on his investigation of somatotype and performance characteristics for the boys' football branch. The illiac skinfold thickness and calf skinfold thickness values of the goalkeepers playing for professional junior football clubs and the triceps skinfold thickness, subscapula skinfold thickness and illiac skinfold thickness values of the goalkeepers playing for amateur junior football clubs obtained in our study are not parallel with those in this study. The differences in the skinfold thickness values of the studies are thought to stem from the differences in the athletes' growth and development characteristics.

Söğüt et al. (2004) conducted a research with the participation of 30 young male tennis players in order to explore their anthropometric and somatotype characteristics and found the following mean values: triceps sk $13,24 \pm 2,78$ mm, subscapular sk $7,01 \pm 2,63$

Table 2: Independent Samples T-Test Values of the Professional and Amateur Goalkeepers.

Parameters	Level	N	X ± SS	O. Difference ± Std	T	P
Weight (kg)	Professional	30	54.05±14.88	0.11±3.83	0.029	0.977
	Amateur	30	53.94±14.80			
Height (cm)	Professional	30	164.33±13.62	4.96±3.36	1.47	0.145
	Amateur	30	159.37±12.39			
Triceps (mm)	Professional	30	8.82±2.94	-2.29±0.93	-2.44*	0.017
	Amateur	30	11.12±4.21			
Subscapular(mm)	Professional	30	6.78±1.74	-1.68±0.88	-1.90	0.061
	Amateur	30	8.46±4.50			
Suprailliac (mm)	Professional	30	5.24±1.85	-2.02±0.94	-2.08*	0.041
	Amateur	30	7.27±4.98			
Calf (mm)	Professional	30	10.44±3.98	-3.76±1.57	-2.39*	0.020
	Amateur	30	14.21±7.61			
Biceps girth (cm)	Professional	30	24.59±3.26	-0.98±0.85	-1.14	0.256
	Amateur	30	25.58±3.38			
Calf girth (cm)	Professional	30	32.65±3.73	-1.30±1.00	-1.29	0.202
	Amateur	30	33.95±4.07			
Humerus breadth (cm)	Professional	30	6.56±0.52	-0.02±0.14	-0.18	0.855
	Amateur	30	6.58±0.59			
Femur breadth (cm)	Professional	30	9.78±0.72	-0.20±0.20	-1.01	0.314
	Amateur	30	9.99±0.84			
Endomorph	Professional	30	2.10±0.92	0.66±0.30	-2.17*	0.034
	Amateur	30	2.77±1.40			
Mesomorph	Professional	30	3.90±1.06	-1.23±0.30	-4.01**	0.000
	Amateur	30	5.13±1.30			
Ectomorph	Professional	30	3.63±1.09	0.86±0.31	2.78**	0.007
	Amateur	30	2.77±1.30			

Table 3: X and Y Values of the Somatocharts of Professional and Amateur Goalkeepers

Variable	Level	N	Min.	Max.	Avg.	St.
X	Professional	30	-2,1	4,6	1,4	1,6
	Amateur	30	-6,3	3,3	-0,1	2,5
Y	Professional	30	-1,5	7,5	2,3	2,3
	Amateur	30	-0,7	10,1	4,7	2,8

x= Ectomorphy – Endomorphy

y= 2 x Mesomorphy – (Endomorphy + Ectomorphy)

mm, suprailliac sk 7,12±3,71 mm, calf sk 19,01±5,32. The skinfold thickness values obtained in their study are not in parallel to those obtained in our study. The differences in the skinfold thickness values of the studies are thought to stem from the differences in the athletes' growth and development characteristics.

Measurements of Girth

Our research revealed that professional goalkeepers had a mean biceps girth of 24,5±3,2 cm and mean calf girth of 32,6±3,7 cm; while amateur goalkeepers had a mean biceps girth of 25,5±3,3 cm and a mean calf girth of

33,9±4,0 cm (Table 1). According to these results, no statistically significant difference was found in biceps and calf girth measurements of goalkeepers playing for the amateur and professional soccer teams ($p>0,05$) (Table 2).

Polat et al. (2003) compared the athletes and sedentary individuals in their study entitled "14 Yaş Çocukların Fiziksel Uygunluk Düzeyleri İle Antropometrik Özelliklerinin İncelenmesi" (A Study on Physical Suitability and Anthropometric Characteristics of 14 Years Old Children) and found no significant difference between calf girth and biceps girth parameters (Polat Y,

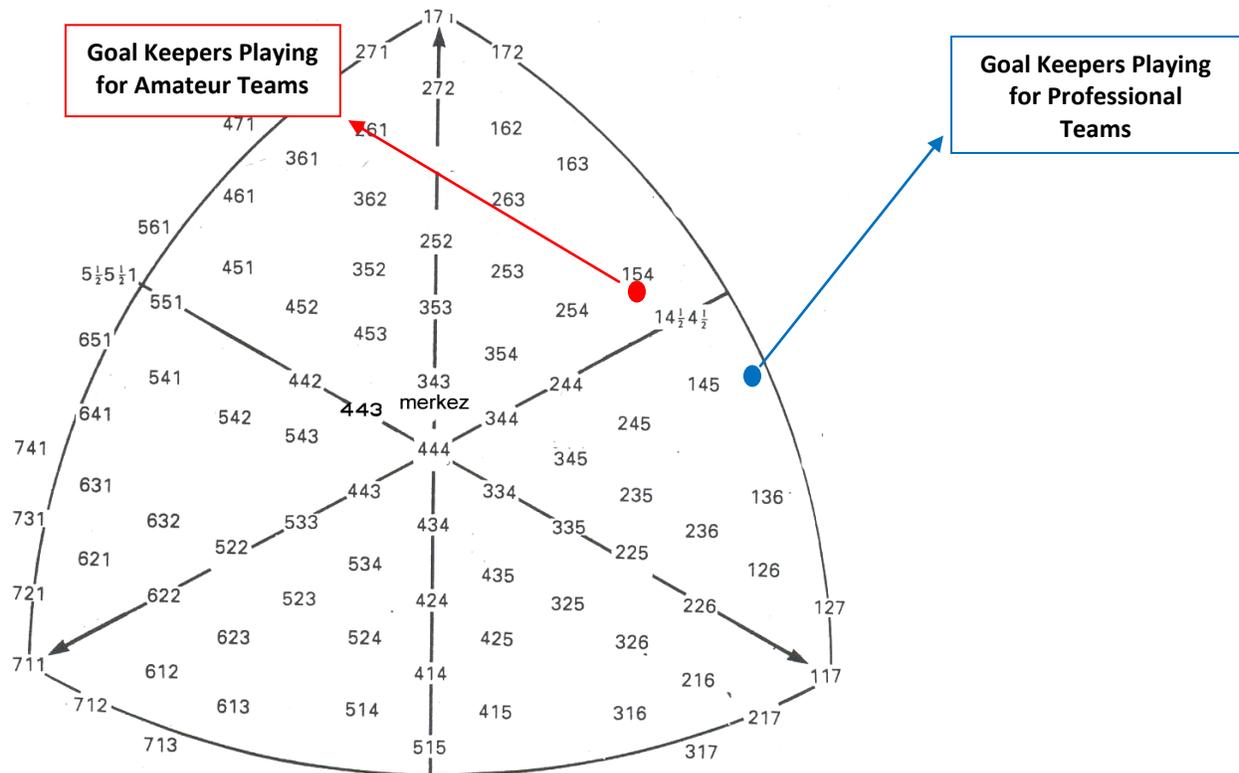


Figure 1: Somatochart Distribution of the Goalkeepers Playing for Professional and Amateur Soccer Teams.

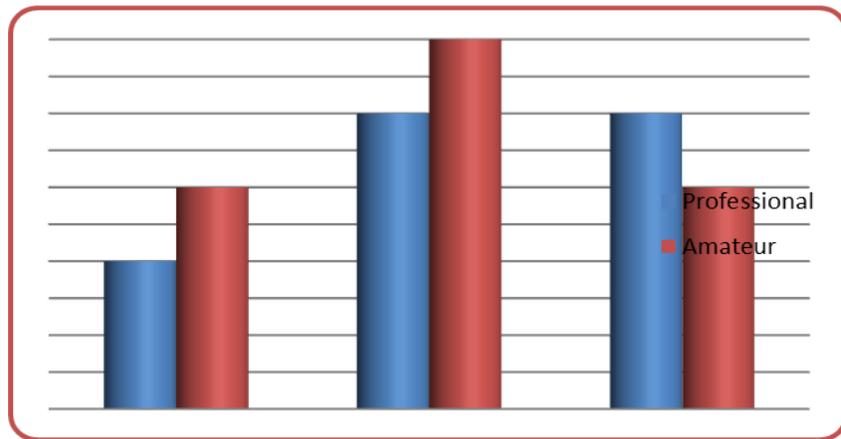


Figure 2: The mean somatotypes (average endomorph, mesomorph and ectomorph values) of the professional and amateur goalkeepers.

2003). Their findings were in line with our findings. Söğüt et al. (2004) studied anthropometrical and somatotype characteristics of 30 junior male tennis players aged between $11,97 \pm 0,18$ years and found that their mean flexor biceps girth was $22,00 \pm 2,42$ cm and mean calf girth was $30,52 \pm 2,60$ cm. The results of their study are not in parallel to those obtained in our study. The

differences in the results of the studies are thought to stem from the differences in the athletes' growth and development characteristics.

Measurements of Breadth

Our study revealed that professional goalkeepers had a mean humerus breadth of $6,5 \pm 0,5$ cm and a mean femur

breadth of $9,7\pm 0,7$ cm; while amateur goalkeepers had a mean humerus breadth of $6,5\pm 0,5$ cm and femur breadth of $9,9\pm 0,8$ cm (Table 1). According to these results, no statistically significant difference was found in the measurements of humerus and femur breadth of goalkeepers playing for the amateur and professional teams ($p>0,05$) (Table 2).

Hazır T. (2010) found the elbow diameter measurement values of copper breadth as $6,90\pm 0,35$ cm and the size of the measurement values femur breadth as $9,87\pm 0,48$ cm. on his physical characteristics and somatotype of soccer players according to playing level and position (Hazır T, 2010). These values are in parallel with the values in our study.

Ayan et al. (2011) found for the measurements of the elbow diameter values as humerus breadth $5,22\pm 0,34$ cm and the measurements of the size of the breadfill breadth $7,94\pm 0,38$ cm. on his investigation of somatotype and performance characteristics for the boys' football branch. The values obtained in their study are not in parallel to those obtained in our study. The differences in the values of the studies are thought to stem from the differences in the athletes' growth and development characteristics.

The differences between our study and other studies in the literature might be due to the differences related to athletes' growth and development processes, genetic and environmental factors and the fact that measurements of athletes in different sports were examined in these studies.

Somatotype Values

Anthropometric measurements and somatotypes have become increasingly important for studies aiming to determine athletic abilities. Studies on anthropometric characteristics usually focus on which sports suit best for different body types and how it affects talent selection. It is well known that usually genetic parameters like height, weight, somatotype and body-mass index, which are also called as structural factors, affect the capabilities and functional factors in sports (Barış et al., 2003).

Results of this study showed that the mean somatotype for the professional teams' goalkeepers was 2-4-4 whilst it was 3-5-3 for the amateur teams' goalkeepers (Table 1). After the measurements, it was found that endomorph ($p<0,05$) and mesomorph ($p<0,01$) values were significant for the amateur goalkeepers; and a significant difference was found in ectomorph values ($p<0,01$) in favour of the professional goalkeepers (Table 2).

Fidelix et al. (2014), found that goalkeepers were predominantly balanced mesomorphs (with somatotype of 3,1-4,1-2,9 in their study, focused on the somatotypes of young soccer players. Gonçalves et al. (2011) also explored the somatotypes of junior goalkeepers and revealed that 11-12-year-old goalkeepers had the mean somatotype values of 3,4-4,7-2,9 and 13-14-year-old goalkeepers had the mean of 2,4-4,4-3,3. Apta A. (2010) found the somatotype value of 2,2-4,1-3,2 as a result of

his study conducted with 122 soccer players aged between 10-18.

The differences between our study and above-mentioned studies in the literature might be due to the differences related to athletes' growth and development processes, as well as genetic and environmental factors.

CONCLUSION

In conclusion, it was found that the goalkeepers playing for the professional teams were mesomorph-ectomorphs, while the goalkeepers playing for the amateur teams were balanced mesomorphs. According to the somatotypes, it is thought that goalkeepers playing for the professional soccer teams had a better physical structure than those playing for the amateur teams.

REFERENCES

- Gualdi-Russo E, Zaccagni L (2001). Somatotype, role and performance in elite volleyball players. *Journal of Sports Medicine and Physical Fitness*. 41: 256-62.
- Açıkada C, Ergen E (1990). *Bilim ve Spor*. Ankara: Büro-Tek Ofset Matbaacılık.
- Hakinken K (1992). Changes in physical fitness profile in female volleyball players during the competitive season. *J. Sports Med Phys Fitness*. 32: 306-16.
- Laessens C, Beunen G, Wellens R, Geldof G (1987). Somatotype and body structure of world top judoists. *Sports Medicine*. 27:105-112.
- Lohman TG, Roche AF, Martorel R (1988). *Anthropometric Standardization Reference Manual*. Illinois: Human Kinetics Books Champaign.
- Ross WD, Marfell-Jones MJ (1991). Physiological testing of the high-performance athlete. In: MacDougall JD, Wenger HA, Green HJ, eds. *Kinanthropometry*. Illinois: Human Kinetics Books Champaign. p: 230.
- Carter JEL, Heath BH (1990). *Somatotyping - development and applications*. New York: Cambridge University Press.
- Heyward VH, Stolarczyk LM (1996). *Applied Body Composition Assessment*. USA: Human Kinetics. p: 10.
- Zorba E, Ziyagil MA (1995). *Vücut Kompozisyonu ve Ölçüm Metotları*. Trabzon: Gen Matbaacılık Reklamcılık Ltd. Şti.
- Ayan V, Kaya M, Erol EA (2011) The Study Of The Somatotypes And Performance Characteristics Of Body For Football Branch, Niğde Üniversitesi Beden Eğitimi Ve Spor Bilimleri Dergisi. 5(3): 266-273.
- Apta A (2010). Body Composition and Somatotype in 10-18 Years Old Male Soccer Players and their Relation with Aerobic Performance and Soccer Injuries. *Fırat Tıp Dergisi*. 15(3): 118-122.
- Söğüt M, Müniroğlu RS, Deliceoğlu G (2004). Investigation of anthropometric and somatotype characteristics of junior male tennis players in different categories. *Sporometre Beden Eğitimi ve Spor Bilimleri Dergisi*. 2(4): 155-162.

- Polat Y (2003). Evolution of 14 years old children's physical fitness levels and anthropometric characteristics. *İstanbul Üniversitesi Spor Bilim Dergisi*. 11(3): 127-130.
- Hazir T (2010). Physical Characteristics and Somatotype of Soccer Players according to Playing Level and Position *Journal of Human Kinetics*. 26: 83-95.
- Bariş L, Minürođlu S, Çoruh EE, Sunay H (2003). The evaluation of somatotype profile of Turkish male national volleyball team. *Spormetre Beden Eğitimi ve Spor Bilimleri Dergisi*. 1: 53-56.
- Fidelix YL, Berria J, Ferrari EP, Ortiz JG, Cetolin T, Petroski EL, et al. Somatotype of competitive youth soccer players from Brazil. *Journal Of Human Kinetics*. 2014, 42, 1, pp: 259-266.
17. Gonçaves RR, Severino V, Coelho MJ, Figueiredo AJ. Age-related variation in anthropometric and maturity characteristics of soccer goalkeepers aged 11-14 years. *Annals of Research in Sport and Physical Activity*. 2011, 1, pp: 69-81.