



RESEARCH ARTICLE

INVESTIGATION OF THE RELATIONSHIP BETWEEN ANTHROPOMETRIC MEASUREMENTS  
AND MUSCLE STRENGTHS OF UPPER EXTREMITY IN FOOTBALL PLAYERS

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ABSTRACT

Although lower extremity is used as primer in football, upper extremities are very important for stability, speed and acceleration. The anthropometric properties of the athletes are one of necessary prerequisites for success that affect the performance. The hand grip strength is accepted as an objective measure for evaluation of upper extremity performance. The aim of our study is to investigate the effects of upper extremity's anthropometric properties, age, height and weight of football players on hand grip strength. 25 male football players participated in this study who are training at least 8 hours a week and have been playing football for at least 5 years. Football players' age, height, weight, anthropometric measurements (length of the upper extremity, circumference of the arm and forearm) and hand grip strength were measured. Measurements were performed for both dominant and non-dominant extremities. As a result, a significant correlation between length of the right upper extremity and the right hand grip strength was found ( $p < 0,05$ ). There was no significant correlation between age, height, weight and hand grip strength of football players ( $p > 0,05$ ). There was no significant difference between grip strengths of dominant and non-dominant extremities ( $p > 0,05$ ). When the obtained data were evaluated, it was thought that the relationship between length of the right upper extremity and the right hand grip strength of football players exists due to being dominant side. It was concluded that anthropometric measurements may have an effect on muscle strength but does not provide sufficient information about muscle strength and therefore muscle strength should be evaluated separately.

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INTRODUCTION

Football is the most popular sport in the World. It requires long lasting strength, endurance, coordination and also great body composition (Aksu, 2015). In addition to this anthropometric features and physical fitness of football players arouses attention of many researchers. Eventhough; lower extremities are primarily used while playing football, upper extremities are also important for balance, speed and acceleration. Muscle strength and anthropometric features of football players are influential for coordination. Anthropometry is a method that gives information about body type and dimensions, which classifies the objective features of the human body according to their dimensions and structure characteristics with specific measurement methods (Otman et al., 2003).

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The anthropometric properties of an athlete, that is the length, width and circumference of body parts, give information on who is more advantageous in the mechanical direction in sports activities. The anthropometric features of body parts are considered as important as the fitness of athletes' body. The anthropometric features of the athletes are accepted as a prerequisite for success as they affect the performance of the athlete (Duncan et al., 2006). Hand grip strength is considered as an objective measurement for assessing upper extremity performance. There are also studies showing that hand grip strength is related to general body muscle strength and pulmonary muscle strength (Nicolay and Walker, 2005). It has been reported that for the hand grip strength to occur, the wrist extensor muscles and the long flexor muscles of the fingers should work in coordination. It is stated that the wrist extensor muscles need to be involved in order to increase the isometric force during gripping (Johanson et al., 1998). The grip strength is measured by a dynamometer. Measurement is easy, fast and reliable. The test position proposed by the American Society of

Hand Therapist (ASHT) was used for the measurement of grip strength in the majority of the studies (Innes, 1999). This method provides a standard approach for comparing measurement results. Grip strength is required at a certain level in many different branches of sport such as football, basketball, baseball, tennis. It has been shown that grip strength values in different sports branches are influenced by gender, age, height, weight, body mass index, dominant hand and many anthropometric features and this can be used in predicting grip strength (Kenji and Demura, 2016, Pizzigalli *et al.*, 2016). As the relationship between muscular strength and anthropometric features can affect the performance of the athletes the aim of our study is to investigate the effects of anthropometric features of the upper extremity on the hand grip strength as well as age, height, and weight of the football players.

## MATERIALS AND METHODS

25 elite male football players who have trained for at least 8 hours a week and played football for at least 5 years participated in our work. The age, height, weight, anthropometric properties and hand grip strength of football players who participated in the study were recorded. Upper extremity length, arm and forearm circumference measurements were performed as anthropometric measurements. Foldable, nonelastic, 7mm wide tape was used in all anthropometric measurements. The distance between the acromion and the longest fingertip, known as the length of the upper extremity, was measured with tape. Arm and forearm circumference measurements were also measured with tape from the most bulging places of the arm and forearm (Ozman *et al.*, 2003). Obtained data were recorded as centimeter. The grip strength was measured in the standard test position with the Baseline brand hydraulic hand dynamometer. According to test position athlete was sat perpendicularly in a chair on the flat floor. The hip and knee flexed at 90 degrees, the shoulder adducted and neutrally rotated, elbow flexed at 90 degrees, forearm in a neutral position, and the wrist between 0 and 30 degrees extension and between 0 and 15 degrees ulnar deviation. Maximum grip was desired from athlete. Measurements were repeated three times and the mean of three trials was recorded as hand grip strength. All measurements were performed for both dominant and non-dominant extremities. Obtained data from study was transferred to the digital environment and statistical analysis was performed with SPSS for Windows 20 package program.

## RESULTS

The average age of the football players who participated in the study is  $19.44 \pm 0.96$  and all of them were male. Demographic features of the football players are shown in Table 1.

**Table 1. Demographic features of football players who participated in the research**

Demographic Features	N	Mean±SD
Age (year)	25	19,44±0,96
Height (m)	25	1,77±0,04
Weight (kg)	25	70,60±4,08
BMI (kg/m <sup>2</sup> )	25	22,31±1,11
Sports Background (year)	25	10,08±3,27

There was no significant difference between anthropometric properties and hand grip strength when the dominant and non-dominant extremities were compared statistically ( $p>0,05$ ) (Table 2).

**Table 2. Comparison of dominant and non-dominant extremity anthropometric properties and hand grip strength of football players who participated in the study**

	Dominant extremity Mean±SD	Non-dominant extremity Mean±SD	p value
Length of the upper extremity (cm)	77,70±3,06	77,52±2,94	0,590
Circumference of the arm (cm)	28,18±1,55	27,90±1,68	0,545
Circumference of the forearm (cm)	25,94±1,28	25,46±1,18	0,177
Hand grip strength (kg)	40,05±6,56	38,89±6,14	0,209

There was no significant correlation between age, height, weight and grip strength of football players ( $p>0,05$ ) (Table 3, Table 4). There was a significant correlation between length of the right upper extremity and right hand grip strength ( $p<0,05$ ). On the other hand, there was no significant correlation between the right arm and forearm circumference measurements and right hand grip strength ( $p>0,05$ ). Moreover there was no significant correlation between length of the left upper extremity, the left arm and forearm circumference measurements and left hand grip strength ( $p>0,05$ ) (Table 3, Table 4).

**Table 3. Correlation between age, height, weight, anthropometric properties and right hand grip strength of the football players who participated in the study**

	Right hand grip strength
Age	CC: 0,091 p: 0,667
Height	CC: 0,135 p: 0,521
Weight	CC: 0,297 p: 0,150
Length of the right upper extremity	CC: 0,409 p: 0,043*
Circumference of the right arm	CC: -0,066 p: 0,753
Circumference of the right forearm	CC: 0,290 p: 0,159

CC: Correlation Coefficient, \* $p<0,05$

**Table 4. Correlation between age, height, weight, anthropometric properties and left hand grip strength of the football players who participated in the study**

	Left hand grip strength
Age	CC: 0,006 p: 0,977
Height	CC: 0,261 p: 0,208
Weight	CC: 0,334 p: 0,103
Length of the left upper extremity	CC: 0,275 p: 0,184
Circumference of the left arm	CC: 0,072 p: 0,733
Circumference of the left forearm	CC: 0,225 p: 0,281

CC: Correlation Coefficient

## DISCUSSION

The anthropometric features and muscular strength of the athletes are the essential prerequisites for success that affect their performance. Agonist-antagonist muscles imbalances can be seen as an injury risk for elite athletes. Therefore stretching and strengthening exercises should be added to the athletes' training programs (Colak, 2012).

In football, training and competitions, especially in the lower extremities are used, but because of the fact that football is a game that requires perfect body composition, the body and upper extremities are also involved. Upper extremities are very important for balance, speed and acceleration during movement. It has been shown that there may be a correlation between anthropometric features and muscle strength in different sports branches studies (Kenji and Demura, 2016, Pizzigalli *et al.*, 2016). In our study, it was investigated the effects of upper extremity's anthropometric properties, age, height and weight of football players on hand grip strength. The average age of 25 male football players participating in the study is  $19.44 \pm 0.96$ . The upper extremity anthropometric features of the athletes (length of the upper extremity, circumference of the arm and forearm) were not statistically different when dominant and non dominant extremities were compared ( $p > 0,05$ ). It was also found that there was no significant difference between football players' dominant ( $40,05 \pm 6,56$  kg) and non-dominant sides ( $38,89 \pm 6,14$  kg) hand grip strength ( $p > 0,05$ ).

There are also studies reporting that there is no significant difference between dominant and non-dominant hand grip strengths (Härkönen *et al.*, 1993). On the other hand, there is difference between dominant and non-dominant hand grip strength of healthy adult subjects in a study (Armstrong *et al.*, 1999). When the different results from the researches are examined, it is seen that the characteristics of the individuals who participated in the studies and the measurement techniques are different. Therefore the effect of hand dominance on grip strength make it difficult to get a definite result. When the obtained data were evaluated, it has been seen that there was no statistically significant relation between grip strength and physical characteristics such as age, height and body weight of football players ( $p > 0,05$ ). Canhadadas *et al.* (2010) reported that grip strength significantly increased with age in a study of young male soccer players. In a different study, there was a relationship between grip strength and height, but there was no relationship between grip strength and body weight (Peolsson *et al.*, 2001). There are studies showing the relationship between physical features and grip strength in different sports branches, as well as the relationship between grip strength and age, gender and anthropometric features in non-athletes (Chau *et al.*, 1997). In a study involving individuals from different occupational groups, it was reported that there was a positive correlation between height, body weight and grip strength, excluding age in all groups (Eryiğit, 2012). It has been concluded that there may be differences in results due to the differences between the sample distribution, including our study.

In a study comparing the grip strengths of football and handball players, the right hand grip strength of the handballs was higher than the football players, while there was no significant difference between the left hand grip strengths of the athletes (İri *et al.*, 2017). This is thought to be due to the more dominant and active use of the upper extremities in handball and basketball than football. There are also studies in which there is no statistically significant difference between the grip strengths of the players in different sports branches, although it is expected that the grip strength will be higher in the sports branches where the hand is used more actively (Akçakaya, 2009). In our study, there was a significant correlation between length of the right upper extremity and the right hand grip strength of football players ( $p < 0,05$ ).

There was no significant correlation between circumference of the right arm and forearm and the right hand grip strength and between length of the left upper extremity, circumference of the left arm and forearm and the left hand grip strength ( $p > 0,05$ ). When the obtained data were evaluated, it was thought that the relationship between length of the right upper extremity and the right hand grip strength of football players exists due to being dominant side.

## Conclusion

When the results obtained from our study were evaluated, it was concluded that the relationship between length of the right upper extremity and the muscle strength of the football players was due to the dominant side. Anthropometric measurements could be effective on the muscle strength, but they could not provide enough information about the muscle strength. It was concluded that muscle strength should be measured separately while evaluating athletes. Training and exercise programs prepared in this way would be more convenient and beneficial to them.

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