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The Comparison of the Anthropometric Characteristics of Iranian Elite Male Soccer Players in Different Game Position

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Abstract: The purpose of the present study was to compare the anthropometric characteristics of elite Iranian male soccer players in different game positions. 85 male Iranian soccer players voluntarily participated in this study. The anthropometric characteristics of these players were measured by International Association of Kinanthropometry (ISAK) scale. Data analysis was performed by SPSS: 13.0 using Kruskal-Wallis and Mann-Whitney-U statistics. The results of analysis showed that the goalkeepers were significantly heavier, taller (stretch stature, sitting height) with longer limb length (arm span, arm, forearm, hand, leg, tibial, foot), limb breadth (humerus, femur) and limb girth (arm relaxed, arm flexed and tensed, gluteal) compared with players in other positions within the field. It was concluded that goal keepers possessed anthropometric characteristics significantly different than other field players.

Key words: Soccer % Anthropometry % Elite % Position

INTRODUCTION

Anthropometric measures and morphologic characteristics play an important role in determining the success of athletes [1-3]. In many sports, these characteristics determine the performance quality and are appropriate screening criterion to select the body type suitable for specific sports [4, 5]. Proper body type analysis makes it possible to identify talents or develop training programs [4, 6]. The majority of sports including soccer require particular body types with specific body composition [7] since the success of any player in the game depends on the personal attributes that the player posses and the positions in which the game is played [8]. It is complicated to identify the morphological characteristics that have significant effects on the performance of the player. Depending on the position, the technical pattern, the type and intensity of tactics used in each match and the total running distance in the game is different for every player [9-11].

The results of some studies show differences in anthropometric characteristics among elite female soccer players in Croatia [12], young non-elite soccer players [13], pro soccer players in Brazil [14], players in Japan Pro League, Spain and Italy, Germany and England leagues [15] and Croatia's elite soccer players [8]. No significant difference in anthropometric characteristics was reported for quadric game positions in Singapore's league [16]. However, anthropometric characteristics are highly dependent on ethnicity and the level of competition. In this regard, a significant difference between English and Malaysian players has been reported [7].

Despite such interest in anthropometric characteristics of athletes, precise and accurate information about the anthropometric characteristics of Iranian elite soccer players is lacking. Therefore, this research was designed to examine whether there was any significant difference in the anthropometric measures of the elite Iranian soccer players in quadric positions played in the game. The results of this study may provide useful information for the coaches and trainers to design tactical programs for their team as well as to save time, resources and to miss the talented athletes plus reliable information to avoid investing on individuals who lack the proper attributes to be successful future athletes.

MATERIALS AND METHODS

The present research was an analytic-comparative research. The statistical population included 461 players invited to Iran's national team for 2010 South Africa World Cup Qualification round plus the players playing

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in Iran's premium league in 2008-2009. A total of 85 volunteer soccer players (9 goalkeepers, 25 defenders, 36 halfbacks and 15 strikers) (mean age 26.03±4.90 yr., height 177.07±14.38 cm and weight 75.33±7.35 kg) were selected. The inclusion criterion included lack of injury, regular participation in training program in addition to being a member of the national team or the premium league within the past six months.

Anthropometric sizes measured in this study included limb lengths (standing height, sitting height, arm span, arm length, thigh length, tibia length, foot sole length), limb breadth (elbow breadth, pelvis breadth, knee breadth) and limb girths (arm relaxed girth, arm flexed girth, back girth, buttocks girth, thigh girth, tibia girth). Measurements were performed using the SECA scale manufactured in Germany with 0.1mm accuracy, Large Isaac Brand Lafayette caliper manufactured in USA with 0.1mm accuracy, small Isaac Brand Lafayette caliper manufactured in USA with 0.1mm accuracy and the elastic tape measure of Lufkin Perth Technical University manufactured in USA with 1mm accuracy and the guide direction of the International Society for the Advancement of Kinanthropometry (ISAK) respectively [17].

After the subjects had been selected, appropriate measures were taken to get access to the authorities in Football Federation, coaches of national team and the coaches and managers of the related clubs to obtain permission to perform the tests. Measurements were performed by attending the field where the team practice sessions were held three days per week (due to different practice periods). After the subjects had been selected, they received instructions about the procedures to be carried out. Then, every subject was examined according to the planned schedule. An anthropometry expert performed the anthropometric measurement. All the data including the personal information of the subjects (full name, activity record and contact info) as well as research data (anthropometric characteristics) were recorded in special forms. The age, weight and standing height of the subjects were recorded before collecting the anthropometric measurements such as limb lengths (sitting height, arm span, arm length, forearm length, palm length, leg length, thigh length, tibia length, foot sole length), limb breadth (elbow breadth, pelvis breadth, knee breadth) and limb girths (arm relaxed girth, arm flexed girth, back girth, buttocks girth, thigh girth, tibia girth). All the measurements were performed after particular points had been marked on the right side of the body. All the sizes were measured three times. The mean value of these measurements was used for statistical analysis.

Statistical Analysis: Descriptive statistics including mean and standard deviation were calculated and reported. Kolmogorov-Smirnov test and Levine's test were applied to examine the normality of the data distribution and their homogeneity of variances. The results of analysis indicated that the data were not normally distributed, thus, parametric statistical methods were not appropriate for the analysis. As a result, non-parametric test such as Kruskal-Wallis procedure was used to compare the means of the anthropometric measures among the quadric game positions. If there was a significant difference among the positions, Mann-Whitney U-tests were used to compare each pair of positions. The significant level was set to "=0.05 for all the tests. All the statistical analyses were performed using SPSS 12.0.

RESULTS

The results of analysis indicated that there was no significant difference in the mean rank of the subjects' age among the quadric game positions (x^2_3=226.3, p=0.85). The goalkeepers were significantly heavier than the halfbacks (p=0.001) and strikers (p=0.005). In addition, goalkeepers were taller than the defenders (p=0.001), halfbacks (p=0.000) and strikers (p=0.000) (Table 1).

As it can be observed, the goalkeepers had significantly higher sitting height, palm length and sole of the foot length than the halfbacks (p=0.000, p=0.002, p=0.000) and the strikers (p=0.002, p=0.003, p=0.000) respectively. On the other hand, the arm span, arm, forearm and leg length of the goalkeepers were significantly longer than the defenders (p=0.000, p=0.000, p=0.001, p=0.000), halfbacks (p=0.000, p=0.000, p=0.000, p=0.000) and strikers (p=0.000, p=0.000, p=0.000, p=0.001) respectively. In addition, the tibia length of the goalkeepers were significantly longer than the defenders (p=0.006) and halfbacks (p=0.001). Also, there was no significant difference in the mean rank of thigh length among the subjects in the quadric game positions (x^2_3=939.6, p=0.074) (Table 2).

The results of analysis showed that the joint breadth and elbow breadth of goalkeepers were significantly larger than the halfbacks (p=0.001). In addition, the knee breadth of the goalkeepers was significantly larger than the halfbacks (p=0.004) and strikers (p=0.004). However, there was no significant difference in the pelvis breadth of the quadric game positions (x^2_3=7.882, p=0.05) (Table 3).

As it can be observed, relaxed girth was significantly higher in goalkeepers than the defenders (p=0.002) and halfbacks (p=0.001). Arm flexed girth and buttocks girth of goalkeepers were significantly larger than the halfbacks

Table 1: Mean and standard deviations of general characteristics of Iran elite soccer players in quadric positions

	Group			
Variant	Goalkeepers N=9	Defenders N=25	Halfbacks N=36	Strikers N=15
Age (year)	26.33(5.76)	24.6(4.77)	26.63(4.98)	26.63(4.98)
Weight (kg)	84.02(7.56)#‡	76.56(7.32)	72.77(6.17)†	74.22(5.97)#
Standing Height (cm)	187.8(3.28)#††	176.72(18.57)	174.77(14.39)	176.75(6.09)

† denotes significant difference compared to the goalkeepers

# denotes significant difference compared to the defenders

‡ denotes significant difference compared to the strikers

Table 2: Mean and standard deviation of the limb lengths (cm) among the elite soccer players in quadric game positions in Iran

	Group			
Variant	Goalkeepers N=9	Defenders N=25	Halfbacks N=36	Strikers N=15
Sitting height	98.35(2.7)	97.35(16.54)	95.43(14.74)†	92.8(4.09)#
Arm span	193.64(5.04)	178.67(20.71)*	177.89(15.378)†	179.62(8.28)#
Arm length	36.35(1.48)	33.92(1.74)*	33.78(1.28)†	33.85(1.65)#
Forearm length	28.02(.96)	25.99(1.05)*	25.62(1.04)†	25.5(1.05)#
Palm length	20.5(.55)	19.82(.62)	19.41(.84)†	19.54(.55)#
Leg length	98.35(1.59)	93.22(3.3)*	91.04(4.04)†	91.66(3.7)#
Thigh length	45.71(2.31)	43.55(2.67)	43.2(2.71)	42.21(3.61)
Tibia length	51.6(2.9)	48.36(2.66)*	47.92(2.05)†	48.71(1.93)
Foot sole length	27.79(.59)	26.66(1.18)	26.25(1.05)†	26.42(.96)#

* Denotes significant difference between goalkeepers and defenders,

† Denotes significant difference between goalkeepers and halfbacks,

# Denotes significant difference between goalkeepers and strikers.

Table 3: Mean and standard deviation of breadth among Iran elite soccer players in quadric game positions

	Group			
Variant	Goalkeepers N=9	Defenders N=25	Halfbacks N=36	Strikers N=15
Elbow breadth(cm)	7.24(.25)	6.39(.36)	6.81(.26)	6.91(.53)
Pelvis breadth(cm)	29.95(1.39)	29(1.32)	28.56(1.32)†	28.76(1.26)
Knee breadth(cm)	10.36(.4)	9.94(.36)	8.83(.42)†	9.74(.41)#

Kruskal-Wallis test significant at "<0.05

Mann-Whitney U-test significant at alpha p<0.008

† Denotes significant difference between goalkeepers and halfbacks

# Denotes significant difference between goalkeepers and strikers

Table 4: Mean and standard deviation of limb girth among Iran elite soccer players in quadric game positions

	Group			
Variant	Goalkeepers N=9	Defenders N=25	Halfbacks N=36	Strikers N=15
Arm relaxed girth (cm)	31.83(2.24)	29.23(1.5)*	28.8(1.87)†	29.74(1.52)
Arm flexed girth(cm)	33.37(2.3)	31.44(1.48)	30.81(1.96)†	32.06(1.58)†
Back girth(cm)	82.3(4.73)	79.06(3.26)	78.82(3.34)	78.84(2.21)
Buttocks girth(cm)	99.78(4.65)	96.69(3.75)	94.79(4.21)†	95.06(3.26)
Thigh girth(cm)	58.73(4.96)	58.42(2.42)	56.74(3.15)	57.56(2.38)
Tibia girth(cm)	38.26(1.51)	39(2.19)	38.15(2.16)	38.34(1.97)

The Kruskal-Wallis test significant at p<0.05

The Mann-Whitney U test significant at p<0.008

* Denote significant difference between goalkeepers and defenders

† is the sign for significant difference between goalkeepers and halfbacks

(p=0.005, p=0.006) respectively. There was no significant difference in the mean rank of back (x^2_3=4.622, p=0.202), thigh (x^2_3=5.680, p=0.128) and tibia girth (x^2_3=2.658, p=0.465) among the quadric game positions (Table 4).

DISCUSSION

The purpose of the present study was to compare the anthropometric measures of Iran elite male soccer players in regard to their game positions. The finding of the study indicated that the goalkeepers had higher weight, height, limb length, limb breadth and limb girth than players in other game positions.

The first finding of the present study showed that the mean age of Iranian soccer players was 26.30 ± 4.9 yr that with the mean age of other famous teams around the world indicated that the means were not significantly different. Bloomfield *et al*. (2005) showed that the mean age of the players in four popular leagues in Europe were as follows: England's premier league (26.3), Spain's La Liga (26.5), Italy's Serie A (26.4) and Germany's Bundesliga (26.6) years old [15]. Reilly (1996) stated that with a standard deviation of approximately two years, the mean age of the first class players ranged between 25 and 27 years old [18]. It needs to be mentioned that there are players under 25 or even 20 years old that are stars in their team [3]. The results of the present study did not show any significant difference in age among the quadric game positions. This finding is in agreement with the results reported for Croatia's elite players [8]. The Croatian goalkeepers were older than the other game positions. Goalkeeper's age rising in Croatia elite women soccer has been reported [12]. However, in the present study, the mean age of goalkeepers was less than the strikers and halfbacks, but the range of difference of goalkeepers' age was wider than other positions. In the four major European leagues, defenders were older than the halfbacks and strikers [15]. Strikers were the youngest in Croatia's Prva HNL league [8]. In Iran's league, strikers, halfbacks and goalkeepers had a close mean age and defenders were younger than others. Such discrepancy may explain the difference in soccer level between Iran and the other advanced countries. The findings showed that the defenders were younger than the goalkeepers, halfbacks and strikers; however, the difference was not statistically significant. It has been documented that most talented soccer players reach their peak performance between 25 and 27 years of age [2]. It is commonly believed that the best results in sports performance are gained between 24 and 27 years old. However, it does not imply that this is the only age at which the highest level of performance is exhibited. There have been players who play soccer at a high level that are either younger than 25 years old or older than 30 years old. For the older, despite the decline in the physiological capacity, they manage to maintain their physical fitness [2]. Comparing the position of the players, it seems that the goalkeepers have a longer playing period. Sporis *et al*. (2007) showed that goalkeepers have more experience in soccer than other game positions [12]. The durability of these players is probably due to the fact that they benefit from their experience in the field and their ability to distinguish various tactics used by teams in the game [2]. These players also benefit from the condition of their position and get hurt less and suffer less from chronic injuries [19]. This is not unusual for high level players to stay in good shape and play well in their thirties [8, 2].

The second finding of the present study showed that the mean weight of Iranian soccer players was 75.33 ±7.35 kg. Bloomfield *et al*. (2005) reported that the mean weight of the players in Germany's Bundesliga was 77.5, England's premier league 73.3, Spain's La Liga 75.0 and Italy's Serie A 74.3 kg [15]. Other study results showed that the mean weight of Norwegian soccer players was 72.2, Saudi Arabian professional players was 73.1 and South American professional players was 76.4 kg [20-22] respectively. This finding showed that the weight of Iranian players was within the same range as the world players. The goalkeepers were significantly heavier than the players in quadric game positions while there was no significant weight difference among the other positions. This finding was similar to what was reported by other studies [11, 20, 23]. On the other hand, the defenders were the heaviest of all the other players except the goalkeepers. The overweight of the goalkeepers may be attributed to the fact that they run shorter distances than the other players [11, 23, 24]. The results of researches showed that goalkeepers run an average of 4 km per game while the defenders run 8 km per match. Other positions run an average of 9 to 12 km per match. In positions where the players are heavier, they have to move against the gravity, thus, it gets harder for them to move and jump for the ball control in a game [25]. The goalkeepers need stronger and more muscular body to engage in air battles against the strikers. More height is an obvious advantage that may compensate for their lower weight. In most studies including the present one, it has been observed that halfbacks' weight is less than other positions. It seems that this condition is an advantage since it enables the midfielders to run and cover more distance than forwards and defenses [7]. Thus, they burn more energy in a match. Halfbacks have less fat percentage and they are shorter than the other players, particularly compared to the goalkeepers [18].

The third finding of the present study indicated that the mean height of goalkeepers was significantly higher than the defenders, halfbacks and strikers. The highest heights belonged to the goalkeepers and the lowest heights were recorded for the strikers. Despite the fact that defenders and strikers had similar heights and were taller than the halfbacks, such difference was not statistically significant. Generally, height is a definite factor in the selection process in soccer [12]. For a team to be successful, it is necessary to have tall goalkeepers and defenders to perform successfully in the air battles during the game whereas height is not a determining factor for the wingers. In fact, since these players try to advance the ball with a high speed, their shorter height can be advantageous to defeat the centre-backs [20, 26]. Since a short height keeps the center of gravity closer to the ground, their dynamic balance is facilitated during dribbling. As it was shown before, goalkeepers were taller than other players [27] with a significant difference between the mean heights of goalkeepers and strikers in most cases. In addition, there was a significant difference between the goalkeepers and midfield players in some studies. The defenders were also taller than midfield players. It seems that the goalkeepers need physical measures different than other positions to protect the goal and make saves. It may sound logical to assume that taller individuals are more talented for the goalkeeping position and as a result they are guided or selected for this position. What is clear regarding the defenders and strikers is that the defenders to resist against the opponent strikers' head blows and the strikers to use the head blows when scoring a goal are required to be taller. Probably more height in strikers in a team makes them a "target" to send high altitude balls. In contrast, short height in players in a team may be advantageous when the strikers attempt to cross the opponent's defence line by dribbling through [10]. Based on the results of previous studies and the results of the present study, it seems that midfield players are shorter compared to other positions. Generally, a short height alone is not a drawback to being successful in soccer. Height characteristics can pave the way for a player to settle in a specific position, therefore, it seems that taller players tend to play in positions like goalkeeping and target striker and relatively shorter players tend to play in midfield and winger positions. Therefore, high height is an advantage for goalkeepers, defenders (especially center defenders) and strikers who use their head to control the ball. On the contrary, midfield players, corner defenders and wingers are typically shorter [2]. The results of Reeves *et al*. (1999), Matkovic *et al*. (2003) and Brocherie *et al*. (2005) studies showed [7, 8, 28] that goalkeepers were significantly higher than midfield players and in some studies higher than strikers [28]. Also, Brocherie *et al*. (2005) and Reeves *et al*. (1999) studies showed that the defenders had a higher mean height compared to midfield players. Such results are similar to the results of the present study [7, 28].

The fourth finding of this study showed that the mean of the sitting height of goalkeepers was significantly higher than the other positions despite the fact that defenders had higher sitting height than the other players except the goalkeepers; such difference was not statistically significant. The higher sitting height in goalkeepers and defenders sets the center of gravity in a higher level in their body which in turn assists them to reach higher height during jumping, thus this condition is advantageous in air battles to control the ball.

The fifth finding of this study indicated that the mean limb length of the goalkeepers were longer than other positions. Physical activity does not increase the length of bones [29]. The length of the limbs is determined by hereditary factors. The longer limb length of the goalkeepers may be associated with their high height, both of which are genetically determined. The mean rank of arm span, arm, palm and leg length and sole of the foot size of the players in the four groups were in correspondence with their height, that is, the higher their height, the longer their limb sizes. However, the mean rank of forearm, thigh and tibia length were not in proportion to the size of height. It was interesting to note that the mean rank of forearm and thigh length of halfbacks were longer than strikers. The mean rank of the tibia length for the strikers was longer than the defenders and halfbacks, plus this size was longer in defenders than the halfbacks.

Sporis *et al*. (2007) and Matkovic *et al*. (2003) showed that goalkeepers had significantly longer legs and arms than other positions [8, 12]. These findings are similar to the results of the present study. Such discrepancy in the size of the legs in goalkeepers may be due to the fact that playing in this position requires such characteristics. Individuals with longer legs and arms have an advantage to play in the goalkeeping position.

The sixth finding of the present study was related to the mean size of the limb breadth. The results indicated that the goalkeepers possessed larger limb breadth than the other positions. It is useful to measure body breadth to determine body build and physique [29]. The larger

body build of goalkeepers compared to the other play positions seems obvious. However, there was no significant difference in pelvis breadth in the quadric game positions. This finding implies that the buttocks of elite soccer players in the quadric game positions are similar. The similarity of the structure may be attributed to the types of training used in soccer. The repeatedly use of sprint runs may cause the bones in this part to grow and change similarly in the quadric game positions. Sporis *et al*. (2007) and Matkovic *et al*. (2003) showed that there are no significant differences in elbow and knee breadth of players in the quadric game positions [8, 12]. These findings are in disagreement with the findings of the present research. This may be partly due to the genetic, ethnical and cultural, nutritional, gender differences and the quality of practices.

The seventh finding of this study showed that the mean of relaxed arm girth of the goalkeepers is larger than that of the defenders and halfbacks. In addition, the means of flexed arm and buttocks girth of goalkeepers are larger than halfbacks. This difference may be due to the different types of game engagement by the goalkeepers in the game. Limited movement, bigger build, more weight and specifically designed practices in long run may make the bones thicker, perform muscle tissue hypertrophy (with more practice with weights) and increase subcutaneous fat (caused by little movement and nutrition level). Limb girths are a function of inner diameter and cross section of the limb; they can be a function of subcutaneous fat thickness, muscular bulk and bone diameter. The increase of myofibril diameter leads to the increase in the size of muscle [29] and it depends on the quantity and kind of physical activity. However, it should be kept in mind that muscular bulk is affected by different factors including genetic, insulin level and balance, growth and steroid hormones, nutrition, kind and quantity of physical activity [29]. Athletes have larger bone diameters than non-athletes since they participate in different types of activity [30]. For instance, the thigh bone in soccer players and the forearm bone in tennis players are thicker; their bone density at any age is higher because they get engaged in athletic trainings [31]. Contrary to the findings of the present research, Sporis *et al*. (2007) and Matkovic *et al*. (2003) showed that arm girth is not significantly different among soccer players in the quadric game position [8, 12]. This difference is probably due to genetic, ethnical and cultural characteristics, nutrition level, sex, kind and quality of the practices. In the present study, there was no significant difference in the mean rank of back, thigh and tibia girth among the players of the quadric game positions. Considering the fact that lower extremity and the middle part of the body of soccer players are more affected than their upper extremity in their training programs in addition to the type of power training in soccer players, bone density and muscle sizes increase more in these locations [32, 33]. The special training eliminates the possible differences between the quadric game position players that may have existed before the beginning of soccer game. Muscle bulk increases considerably in soccer players, particularly in the lower parts [33]. The results of the research conducted by Sporis *et al*. (2007) and Matkovic *et al*. (2003) confirmed the finding of the present research that reported no significant difference between the thigh and tibia girth of the quadric game position players [8, 12]. This similarity in the size may be attributed to the nature of soccer game.

CONCLUSION

In conclusion, the significant differences in the anthropometric measures of soccer players are only noticeable in the goalkeepers. However, there are some differences in anthropometric characteristics of other players in other positions (defense, halfback and strikers) which are not statistically significant. This anthropometric difference may be due to technical, tactical and special role that a player has in a match. Therefore, the findings of this study may increase the knowledge of the trainers, coaches and team managers to identify proper individuals for the right positions to play in the game. In addition, it may assist us in recommending and determining the proper training for the players in the quadric game positions.

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