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Research Article

Positional Comparison on Selected Body Circumferences Variable of Football Players

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ABSTRACT

The objective of the research had been to determine and compare specific body circumference variables among football players in relation to their positions on the football field. From twenty-one different football coaching camps in the Indian suburb of Kolkata, 319 male positional football players were chosen as subjects. In this study, selected body circumference variables included upper arm circumference, chest circumference, hip circumference, thigh circumference and calf circumference among the positional groups were evaluated through standardised procedures. The analysis of the data was performed by applying SPSS programme (Version 20.0). In the statistical analysis, to determine the differences among the groups that were statistically significant as well as to identify which group stood out from the others, one-way analysis of variance and post-hoc comparing of means was performed. In all variables, including upper arm circumference, chest circumference, hip circumference, thigh circumference and calf circumference among the positional groups. The results demonstrated a significant difference in mean. Goalkeepers had considerably larger upper arm circumferences than forwards, midfielders and defenders, according to the findings. The results also showed that the goalkeeper was superior in chest and hip circumferences than that of forward and midfielder. Likewise, Defender group significantly superior in thigh circumference than that of midfielder. Contrariwise, midfielder was significantly inferior in chest and hip circumferences in comparison to goalkeeper and defender groups. Therefore, it is clear that the goalkeeper's calf circumference was noticeably larger than that of the midfielder. However, five calf circumference cases have not revealed any statistically significant changes.

Keywords: Anthropometry, circumference and playing positions.

Introduction

One of the most played sports on Earth, association football is frequently referred to as Football or Soccer. Today football is played globally at amateur level and at professional level with high skilful performance for enormous pleasure to the spectator. Therefore, Football is an inseparable part of our life.
In course of football playing, position of players on field are very vital for winning and it is now globally applied. Based on the FIFA Pro World XI award, researchers categorised the football players into four groups according to specific playing positions: Goalkeeper, Defender, Midfielder and Forward.
The playing position in football along with different formations of the play is based upon the physical characteristics, physical fitness, physiological potentialities, skill and level of the performers. That's why, the anthropometric characteristics of football players in relation to playing positions are highly important with the football performance. Anthropometry is a scientific and logical area of study which deals with the human size,

shape, proportion, composition, metalation and gross function in order to promote realizing growth, ability, exercise, fitness, performance and nutrition. The elite football players require important specific positional anthropometric characteristics, more specifically body mass, stature, body diameter, body circumference, body composition and somatotype for the high-level performance and for the success during game.
Body circumference, commonly known as Body Girth that is most important anthropometric parameter which have a significant relationship with the team selection and team performance for the good results in the football game.
Football is currently played methodically with the use of technical rules applying several systems to emerge victorious in the game. Therefore, we should not consider the Body circumferences of footballers, rather we have to consider the positional body circumferences of goalkeeper, defender, midfield and forward. These positional body circumferences are highly beneficial for the team selection, team performance and the team overall success. The training schedules of the positional players have some similarities and dissimilarities. So, the positional anthropometry is highly associated with the specific positional players. Long-term positional play influences anthropometric characteristics of the players that influences their performance as well.
Some expert researchers had conducted investigations on same variables and found that goalkeeper was significantly superior in upper arm circumference than that forward, midfielder and defender (Sodhi 1991; Saha, Kundu & Mondal, 2014). On the other hand, research also found that defender possessed larger upper arm circumference than that other positional football players (Hailu, E., Kibret, D., Tomay, A. ,2016).
Similarly, the calf circumference of the goalkeeper was considerably larger than that of the midfielder (Sodhi, 1991). But many contradictory results had been observed in various research pieces where defender possess significant large calf circumference mentioned by Saha, Kundu & Mondal 2014; Hailu, Kibret &Tomay, 2016.
The condition of body circumferences is currently of great interest to the researchers, who have also keen to compare among the all groups in light of their various position of football field. Due of this, the current study focuses primarily on body circumferences and positional play in modern football.

Purpose of the study
The primary objective of this study is to compare specific body circumferences among groups of football players who play in diverse positions, such as goalkeepers, defenders, midfielders and forwards.

Methodology

Subjects of the Study
319 male players of football, ages 18 to 24, who participated in numerous football coaching camps in Kolkata, India, became the study's subjects. According to the subsequent purposive sample criteria, the following subjects had been selected -
1) Minimum three years of training age.
2) State, Inter-university participation, District and club contests in Kolkata.
319 football players in all were divided into the four positional categories shown below –
a) Group **GK**: Goalkeeper (Total numbers=49)
b) Group **DF**: Defender (Total numbers =100)
c) Group **MF**: Midfielder (Total numbers =100)
d) Group **FW**: Forward (Total numbers =70)

Criterion Measures and along with Equipment used and Procedure of Test of selected Body Circumference variables
In this study the Body Circumferences or Girths were consider as the criterion measures for testing the hypothesis. The following Body Circumferences variables along with the instruments, procedure of test and scoring unit have been mentioned in below in the table -

Table1: Criterion Measures and along with Equipment used and Procedure of Test of selected body circumference variables

SL No.	Variables (Name & Definition)	Equipment, method of testing and scoring.
1	**Upper Arm Circumference (Relaxed)** **Definition:** The arm circumference at mid-acromial radial point perpendicular in respect of long axis of the arm.	➢ Anthropometric tape equipment was used. ➢ The subject was instructed to stand in relaxed mood, equal weight in both feet and free position of the arm by the sides, without creating any stress of any muscle. In order to allow the tape to pass the arm, cross hand technique was followed around the arm; slight abduction of the subject's right arm was directed. The scholar was using cross wise technique for rubbing the arm muscle appropriately for measurement. ➢ The circumference was recorded in centimetre.
2.	**Chest Circumference**	➢ Anthropometric tape equipment was used.

	Definition: Chest circumference at the point of Meso-sternal side perpendicular in respect of thorax.	➢ The subject had instructed to standing in relaxed position, equal weight on both feet, hanging arm by the side, the measuring tape wrapped cross hand technique around his chest at the point of front Meso-sternale side, the subject maintain breath normally but the measurement was taken at the end of a normal expiration. ➢ The circumference was recorded in centimetre.
3.	**Hip Circumference** **Definition**: The buttocks circumference at the level of maximum posterior protuberance site, perpendicular in respect of long axis of trunk.	➢ Anthropometric tape equipment was used. ➢ The subject was told to stand with equal weight on feet and gluteal muscle to be kept relaxed without any stress. Thereafter, the researcher stubbed the measuring tape on the particular area using cross-hand technique properly. ➢ The circumference was recorded in centimetre.
4.	**Mid-Thigh Circumference:** Mid-thigh circumference at the point of Mid trochanterion-tibiale lateral site which perpendicular in respect of long axis.	➢ Anthropometric tape equipment was used. ➢ The subject had been instructed to stand in a relaxed position, equal weight on both feet, hanging arm by the side. The subject's right foot was separated for the measurement. The expert stubbed the tape on the particular area which mentioned above using the cross-hand technique appropriately at an exposed area of the mid-thigh girth. ➢ The circumference was recorded in centimetre.
5.	**Calf Circumference** **Definition**: The calf circumference at the point of medial calf perpendicular in respect of long axis.	➢ Anthropometric tape equipment was used. ➢ The subject had been instructed to stand in relaxed position, equal weight on both feet, hanging arm by the side. The subject's right foot was separated for the measurement. The expert stubbed the tape on the particular area which mention above using the cross-hand technique appropriately. The expert stubbed the measuring tape around calf especially on the largest proportion of bulge of that muscle, using the cross-hand technique correctly. ➢ The circumference was recorded in centimetre.

Statistical Analysis

The Statistical Package for the Social Sciences (SPSS, Ver. 20.0) has implemented in the current study to analyse the data. The research study adopted the mean and standard deviation of various body circumference variables. Then, One-way ANOVA was used to determine whether there was any statistically significant difference that exists between football players according to their position on the field. After the one-way analysis of variance, post-hoc analysis (Scheffe Test) was applied to figure out which group differed from the others.

Results

The following tables exhibit several body circumference characteristics from the current research combined with the personal information of various football position players.

Table 2: Participant characteristics (Mean and Standard Deviation).

Variables / Groups	Age (yrs.)	Height (cm.)	Weight (kg.)
Goalkeeper (N= 49)	21.35 ± 2.02	173.24 ± 4.62	63.67 ± 5.69
Defender (N = 100)	21.02 ± 1.97	169.95 ± 5.09	59.74 ± 6.34
Midfielder (N= 100)	20.63 ± 2.07	166.87 ± 3.98	55.18 ± 3.61
Forward (N= 70)	20.50 ± 1.88	168.81 ± 5.17	57.44 ± 5.42

Body Circumferences

Table 3: Comparative statistics of Body Circumferences variables of football players.

Groups / Variables	GK	DF	MF	FW	F value	P value (sig.)
Upper arm circumference (cm)	27.41±1.68	26.42±2.02	25.55±1.97	25.49±1.95	13.40*	0.00
Chest	83.26±3.74	81.95±4.60	79.63±3.51	80.49±5.02	9.94*	0.00

Circumference (cm)						
Hip Circumference (cm)	88.51±5.57	87.01±5.01	84.83±3.43	85.79±5.39	7.69*	0.00
Thigh Circumference (cm)	51.13±3.87	50.96±3.94	49.13±3.33	50.80±6.26	4.01*	0.01
Calf Circumference (cm)	34.76±2.09	33.78±3.80	32.92±2.06	33.55±1.74	5.32*	0.00

**= sig. when p<0.05. GK-Goalkeeper, MF-Midfielder, DF-defender, FW-Forward.*

Table 3 exhibits how the factors related to body circumferences are displayed in the above table with descriptive statistics and analysis of variance. The table shows that there are notable mean differences in upper arm circumference, chest circumference, thigh circumference, hip circumference and calf circumference among the positional groups.

For the purpose of determining the real status of the distinct groups (goalkeeper, defender, midfielder and forward), post hoc analysis (Scheffe test) had been utilised as all five variables' F-values were determined to be statistically significant.

Table 4: Post hoc test (Scheffe's method).

Variables	**Playing Positions**		**MD**	**Sig.(p-value)**
Upper arm circumference (cm.)	Goalkeeper (27.41)	Defender (26.42)	0.99216*	0.04
		Midfielder (25.55)	1.86316*	0.00
		Forward (25.49)	1.92173*	0.00
	Defender (26.42)	Midfielder (25.55)	0.87100*	0.02
		Forward (25.49)	0.92957*	0.03
	Midfielder (25.55)	Forward (25.49)	0.06	1.00
Chest Circumference (cm.)	Goalkeeper (83.26)	Defender (81.95)	1.30	0.38
		Midfielder (79.63)	3.62510*	0.00
		Forward (80.49)	2.76224*	0.01
	Defender (81.95)	Midfielder (79.63)	2.32200*	0.00
		Forward (80.49)	1.46	0.19
	Midfielder (79.63)	Forward (80.49)	-.86	0.64
Hip Circumference (cm.)	Goalkeeper (88.51)	Defender (87.01)	1.50	0.35
		Midfielder (84.83)	3.68020*	0.00
		Forward (85.79)	2.71735*	0.03
	Defender (87.01)	Midfielder (84.83)	2.17800*	0.02
		Forward (85.79)	1.22	0.44
	Midfielder (84.83)	Forward (85.79)	-.96	0.64
Thigh circumference Circumference (cm.)	Goalkeeper (51.13)	Defender (50.96)	.17	1.00
		Midfielder (49.13)	2.01	0.08
		Forward (50.80)	.33	0.98
	Defender (50.96)	Midfielder (49.13)	1.83600*	0.03
		Forward (50.80)	.16	1.00
	Midfielder (49.13)	Forward (50.80)	-1.68	0.11
Calf Circumference (cm.)	Goalkeeper (34.76)	Defender (33.78)	.97	0.23
		Midfielder (32.92)	1.83470*	0.00
		Forward (33.55)	1.21	0.12
	Defender (33.78)	Midfielder (32.92)	.86	0.16
		Forward (33.55)	.23	0.96
	Midfielder (32.92)	Forward (33.55)	-.63	0.52

*MD- Mean Difference *= significant (p<0.05).*

The post hoc analysis of selected body circumference variables in relation to playing positions of football player are shown in Table 4.

It represents that the difference among upper arm circumference of goalkeeper in contrast to defender, midfielder and forward which were statistically significant with the p-values of 0.04, 0.00 and 0.00 ($p<0.05$). Moreover, the mean difference of upper arm circumference between defender compared with midfielder and forward was significant with p-values of 0.02 and 0.03 ($p<0.05$). However, there were no statistically

significant differences was observed of upper arm circumference between midfielder and forward because the p-value was 1.00 (≥ 0.05).

Above table also reveals that the difference of mean in terms of chest circumference of goalkeeper to compare with forward and midfielder were significantly different with the p-values of 0.01 and 0.00 respectively *(p<0.05)*. Likewise, the mean difference of chest circumference between defender and midfielder was statistically significant with p-values of 0.00 *(p<0.05)*. However, not significant difference of chest circumference was found between goalkeeper and defender because the p-value was 0.38 which is bigger than equal to (≥) 0.05. In fact, any significant differences of chest circumference have not founded during comparing forward with defender and midfielder because p-value were 0.19 and 0.64 respectively ($p \geq 0.05$).

Table represents that the difference of mean of hip circumference among goalkeeper to contrast with forward and midfielder were significantly different with p-values of 0.03 and 0.00 *(p<0.05)*.Similarly, the difference of mean of hip circumference between midfielder and defender was statistically significant as the p-value for this difference was 0.02 *(p<0.05)*.But, there was no statistically significant difference of hip circumference between goalkeeper and defender because the p-value was 0.35 ($p \geq 0.05$).Furthermore, there were no statistically significant differences between hip circumference of forward to compare with defender and midfielder because p-value were 0.44 and 0.64 ($p \geq 0.05$).

Table represents the mean difference of mid-thigh circumference between defender and midfielder was statistically significant as the p-value was 0.03 *(p<0.05)*. But there was not any statistically significant difference existed in five cases of mid-thigh circumference as ($p \geq 0.05$).

Table represents the mean difference of calf circumference between goalkeeper and midfielder which were statistically significant as the p-value was 0.00 *(p<0.05)*. That's how, there was not any difference in statistical significance has been founded in all five cases of calf circumference.

Table 5. Post Hoc analysis (Scheffe Test) of Four Positional Groups of Football Players

Groups / Variables		Playing Position of Football Player					
		GK *vs* DF	GK*vs*MF	GK*vs* FW	DF*vs*MF	DF *vs* FW	MF *vs* FW
Body Circumferences	**Upper arm**	S	S	S	S	S	*NS*
	Chest	*NS*	S	S	S	*NS*	*NS*
	Hip	*NS*	S	S	S	*NS*	*NS*
	Thigh	*NS*	*NS*	*NS*	S	*NS*	*NS*
	Calf	*NS*	S	*NS*	*NS*	*NS*	*NS*

NS - Not Significant, S-Significant at 0.05 level.

Discussions on Finding

Body circumference is the most important anthropometric parameter which had a significant relationship with the performance all games and sports. Body circumference is related to body mass, body size and also significantly related with strength. In the present study, researchers considered upper arm, chest, hip, thigh and calf as the most common body circumferences.

Upper arm

As per the result of this present study, goalkeeper was significantly superior in upper arm circumference than that forward, midfielder and defender. Similar result has been observed by Saha, Kundu & Mondal (2014); Sodhi (1991). According to the observation of Hailu, E., Kibret, D., Tomay, A. (2016)) defender possessed larger upper arm circumference than that other positional football player. Considering the position of football players, it is said that upper arm circumference of goalkeeper has a direct relation with the game performance. Likewise, forward was slight inferior in upper arm circumference. Similar findings had also been mentioned by Hailu, Kibret and Tomay (2016). However, the upper arm circumference of the goalkeeper was higher due to physique and nature of arm movement.

Chest

The goalkeeper's chest circumference was significantly greater than that of the midfielder and forward, but there was not any significant difference observed between goalkeeper and defender. On the other hand, midfielder was significantly inferior in chest circumference than that of goalkeeper and defender. Regarding this issue, midfielders are generally slight short and lean; even less in lean body mass and cover maximum distance during play. These are considered as the main factors of less chest circumference.

Hip

This research shows that goalkeeper was superior in hip circumference than that of forward and midfielder. Whereas, midfielder was inferior in hip circumference. The hip circumference of the goalkeeper was higher due to nature of movement and cover less distance during game. On the other hand, midfielder was significantly

inferior in hip circumference than that of goalkeeper and defender. Midfielders are generally short and lean, even less in lean body mass, less fat distribution in hip region and cover maximum distance during play. These are the important factor of less hip circumference of midfielder. The result of the current study reflects the significance differences in hip circumference among different positional football players.

Thigh

The result of this paper depicted that the mean value of goalkeeper was higher in respect of thigh circumference. Defender group significantly superior in thigh circumference than that of midfielder. However, similar kind of result has also been observed by Hailu, E., Kibret, D., Tomay, A. (2016). Considering the playing position of thigh circumference, the mean value of goalkeeper was higher but not statistically significant which also mentioned in the findings of Sodhi, H. S. (1991). Considering the position of football players, it can be said that thigh circumference of goalkeeper as the positive significance with the performance. Considering the initial anthropometric variables like body weight, height, percentage of body fat of the goalkeeper and defender were better than that of other positional players. Moreover, goalkeeper and defender usually cover less distance during game due to their playing position. Goalkeeper and defender are specially involved in skill like high drive and spot vertical jump either for heading by the defender or receiving and also during ball clearance by the goalkeeper. Basically, the involvement of quadricep and hamstring group of muscles are more responsible in this situation. So that, these might be the causes of greater thigh circumference among goalkeeper and defender.

Calf

The result of the present investigation delineates that the goalkeeper was significantly higher in calf circumference than that of midfielder. Similar outcome has also been observed by Sodhi, (1991). But in many research studies contradictory result had been observed where defender possess significant large calf circumference which is also observed by Saha, Kundu & Mondal (2014), Hailu, Kibret and Tomay (2016). Considering the position of football player, it is said that calf circumference of goalkeeper has the positive role with the performance. Goalkeeper and defender perform strong high drive and spot jump vertically either for heading by the defender or receiving and ball clearance by the goalkeeper. During this situation the involvement of calf muscle group are more responsible for that movement execution. So, these might be the causes of greater calf circumference between goalkeeper and defender. The discussion concerns regarding the topic in respect to playing position highly beneficial but this paper suggests that numerous numbers of studies are needed by taking a multi-varies approach to examine the appropriate comparison the body circumferences in relation to playing position with overall football performance.

Conclusion

Upper Arm Circumference

The upper arm circumference of goalkeeper group was superior followed by defender group, midfielder group and forward group. Similarly, the upper arm circumference of defender group was superior to midfielder group and forward group.

Afterall, there was not any significant difference observed in upper arm circumference between midfielder group and forward group.

Chest Circumference

In respect of chest circumference, the group of goalkeepers was higher than forward and midfielder groups. Similarly, defender group was higher than midfielder group in respect of chest circumference.

After comparing chest circumference researchers further analysed the outcome among the three separated groups like, the goalkeeper group and defender group, the defender group and forward group as well as the midfielder group and forward group. The researches did not reveal any significant differences among the three separated groups.

Hip Circumference

In respect of hip circumference, goalkeeper group was higher in comparison to midfielder and forward group. Equally, the defender group had a larger hip circumference than the midfielder group.

Likewise, no significant difference in hip circumference comparison between goalkeeper and defender group has been traced. Similarly, comparison within defender and forward group and comparison between midfielder and forward group also have not been found any serious difference.

Thigh Circumference

In respect to thigh circumference, defender group was significantly higher than midfielder group but there was no important difference observed in between comparison with remaining groups.

Calf Circumference

In respect of calf circumference, goalkeeper group was comparatively larger than midfielder group but there were no concerning differences traced in between comparison with other groups.

Recommendation for Practical Application

Ideal research becomes apt and true to its sense if it can be applied in real sense to develop a field in its all sectors. The following proposals for practical applications for the improvement of football have been supplied by the current research study which are listed below-

1. People who are involved in competitive football should take into account more than just positional play and formation coaching; they should also place equal weight on body circumference that can be assumed from the results of the current study.
2. The findings of the study can be used to forecast future player performance in relation to positional play and other areas of talent exploration including player selection as well.

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