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Study of anthropometric characteristics among the university level archers

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Abstract

In the present study, the anthropometric measurements and body composition of the university level archers were evaluated and association of these parameters with performance of archers also assessed. A total 30 university level archers ($n=30$; 15 males and 15 females) were selected as subjects. The height, weight, body lengths, diameters, circumferences and skinfold thicknesses were measured of the subjects. From these variables, the body composition components were calculated. The independent samples t-test revealed that the male archers had significantly greater anthropometric variables viz. height ($p<0.05$), arm length ($p<0.05$), lower arm length ($p<0.05$), biacromial diameter ($p<0.05$), bicondylar humerus diameter ($p<0.05$), wrist diameter ($p<0.05$), hand diameter ($p<0.05$), bicondylar femur diameter ($p<0.05$) and lean body mass ($p<0.05$) as compared to female archers. The female archers had significantly greater calf skinfold ($p<0.05$), percent body fat ($p<0.05$) and total body fat ($p<0.05$) than the male archers. The correlation analysis showed that the anthropometric characteristics did not show any association with the performance among the male, female and combined group archers.

Keywords: Anthropometry, Archers, Body Composition, Percent Body Fat, Lean Body Mass

Introduction

The archery is originally one of the oldest forms of human hunting and for a long time played an important role as a long-range weapon in armed conflict. The archery is a sport of precision and concentration in which competitors attempt to shoot their arrows at the center of a target with their bows. Historically, archery was used for hunting and fighting, while in modern times, its main use is that of a sport. A person who participates in archery is typically known as an archer. Archery is a sport in which the participant uses a bow to shoot arrows at a target which has ten concentric circles. The score of each arrow depends upon where it lands on the target. The highest score, a ten, is achieved by shooting an arrow into the center, or bull's-eye. Scores go down from nine for the next circle out to one for the outermost circle. Missing the target results in a score of zero for that arrow. For indoor compound archery, a ten is scored only when the arrow lands inside the inner ring. After each end of arrows is shot, the arrows are scored. The number of hits (non-zero scores), tens and Xs (hits within the inner ten ring) are also recorded for the purpose of breaking ties in the final scores.

Anthropometry has a rich tradition in sports sciences and sports medicine. Though, in different times, different terms were used like dynamic anthropometry, sports anthropometry, biometry, physiological anthropometry, anthropometric measurements, kinanthropometry etc. by scientists to establish some relationships between the body structure and the specialized functions required for various tasks [1]. In fact, it is well established that each individual is unique. The extent of human variability is so enormous that no two individuals can ever be exactly the same. There are two fundamental causes for this variation. One is the genes inherited from parents and the other is the infinity of environment which acts upon individuals from cradle to grave. Therefore, scientists have always been fascinated by the phenomenon of human variation. In the populations, the law of chance operates as a whole and people in general tend to fall along a curve of normal distribution on all traits [2]. With the innumerable variety of human physique, it has become a generalized consideration that some sports events are more suitable to individuals with specific physique than others [3-5]. It has been well established that specific physical characteristics or anthropometric profiles indicate whether the player would be suitable for the competition at the highest level in a specific sport [6-10].

These anthropometric and morphological parameters are the sensitive indicators of physical growth and nutritional status of the athletes for their maximal performances [4, 11]. The present study, therefore, aims at evaluating the anthropometric characteristics of male and female university level archers and also to assess the association (if any) of anthropometric characteristics with the performance of archers.

Methodology

The purpose of the study was to evaluate anthropometric characteristics and to determine the relationship of anthropometric characteristics with performance among archers. For this purpose, 30 subjects comprising of 15 male and 15 female archers were purposively selected from Guru Nanak Dev University, Amritsar. The portable weighing

machine was used to assess the body weight of the subjects. Height and lengths of upper and lower extremities were measured using the standard anthropometric rod. Sliding caliper was used to record the widths and diameters of body parts of the subjects. Flexible steel tape was used to measure the circumferences of the body parts of the subjects. Slimguide skinfold caliper was used to measure the skinfold thicknesses of the body parts of the subjects. The best score of the subjects during competitions viz. inter-college or inter-university was taken as the performance score.

Body Composition

Siri [12] and Durnin and Womersley [13] equations were used to calculate the percentage body fat from the sum of skinfolds. Body density was calculated using the following regression equations

For Males	For Females
17 to 19 years age group Body Density (gm/cc) = 1.1620-0.0630 (X)	17 to 19 years age group Body Density (gm/cc) = 1.1549-0.0678 (X)
20 to 29 years age group: Body Density (gm/cc) = 1.1631-0.0632 (X)	20 to 29 years age group: Body Density (gm/cc) = 1.1599-0.0717 (X)

Statistical Analyses

Statistical analyses were performed using SPSS version 16.0 for windows (SPSS Inc, Chicago, IL, USA). The data was presented as descriptive statistics such as mean, standard deviation, minimum value and maximum value. Student's independent samples t-test was applied to compare different

groups. Karl Pearson's product moment co-efficient of correlation was computed to assess the relationship of anthropometric characteristics with performance of the archers. Significance levels were set at $p < 0.05$.

Results

Table 1: Anthropometric characteristics of the female and male archers

Variables	Female Archers (N=15)		Male Archers (N=15)		t-value	p-value
	Mean	SD	Mean	SD		
Height(cm)	162.87	4.53	169.73	3.53	4.626	0.000*
Weight (kg)	57.13	6.47	58.60	7.38	0.578	0.568
Body Mass Index (kg/m ²)	21.52	2.07	20.31	2.20	1.547	1.33
Arm Length (cm)	75.01	2.33	78.10	3.36	2.921	0.007*
Upper Arm Length (cm)	32.63	2.03	33.36	1.42	1.143	0.263
Lower Arm Length (cm)	42.38	3.36	44.07	3.65	2.562	0.016*
Hand Length (cm)	17.53	0.753	17.94	1.162	1.156	0.258
Biacromial Diameter (cm)	36.94	1.59	38.49	1.80	2.503	0.018*
Bicondylar Humerus Diameter (cm)	5.91	0.424	6.41	0.509	2.921	0.007*
Wrist Diameter (cm)	4.73	0.330	5.04	0.329	2.545	0.017*
Hand Diameter (cm)	6.44	0.580	7.14	0.483	3.588	0.001*
Bicondylar Femur Diameter (cm)	8.32	0.461	8.74	0.544	2.278	0.031*
Upper arm circumference (cm)	26.28	1.92	26.20	2.12	0.117	0.908
Fore arm circumference (cm)	22.16	1.56	23.25	1.92	1.698	0.101
Wrist circumference (cm)	16.12	1.67	16.23	0.797	0.602	0.552
Thigh circumference (cm)	43.94	4.96	42.60	5.79	0.684	0.500
Calf circumference (cm)	18.46	2.41	14.14	3.78	0.122	0.904
Biceps skinfold (mm)	10.98	2.47	9.91	3.13	1.042	0.307
Triceps skinfold (mm)	14.55	3.86	13.26	3.03	0.132	0.877
Subscapular skinfold (mm)	13.74	2.60	13.06	3.05	0.655	0.518
Supra-iliac skinfold (mm)	9.55	3.54	8.56	2.38	0.894	0.379
Calf skinfold (mm)	18.46	2.41	14.14	3.78	3.729	0.001*
Percent Body Fat (%)	26.33	2.31	18.77	1.97	9.623	0.000*
Total Body Fat (kg)	15.10	2.62	10.99	1.66	5.028	0.000*
Lean Body mass (kg)	42.03	4.36	47.60	6.15	2.862	0.008*

* Indicates $p < 0.05$

The various anthropometric characteristics of the female and male archers are presented in table 1. The mean height of female archers was 162.87cm and standard deviation was 4.53. The male archers had average height of 169.73 cm with standard deviation 3.53. Male archers were found to have significantly greater height ($t=4.626$, $p=0.000$) as compared to female archers. The weight of female archers was 57.13 kg with standard deviation 6.47. On the other hand, the weight of male archers was 58.60 kg with standard deviation 7.38. The female archers had 21.52 kg/m² body mass index along with standard deviation 2.07. The body mass index of the male

archers was 20.31 kg/m² with standard deviation 2.20. There were no significant differences among female and male archers with regard to the weight and body mass index. The mean arm length of female archers was 75.01 cm with standard deviation 2.33. The male archers had arm length of 78.10 with standard deviation 3.36. The upper arm length of female archers was 32.63 cm with standard deviation 2.03. Whereas the upper arm length of male archers was 33.36 with standard deviation 1.42. The mean of lower arm length of female archers was 42.38 with standard deviation 3.36. The male archers had lower arm length of 44.07 with standard

deviation 3.65. Male archers were found to have significantly greater arm length ($t=2.921$, $p=0.007$) and lower arm length ($t=2.562$, $p=0.016$) as compared to female archers. The female archers had 17.53 hand lengths with standard deviation 0.753. The hand length of the male archers was 17.94 with standard deviation 1.162. There were no significant differences among female and male archers with regard to upper arm length and hand length. The mean of biacromial diameter of female archers was 36.94 cm with standard deviation 1.59. The male archers had biacromial diameter of 38.49 cm with standard deviation 1.80. The bicondylar humerus diameter of female archers was 5.91 cm with standard deviation 0.424. On the other hand, the bicondylar humerus diameter of male archers was 5.04 cm with standard deviation 0.329. The mean of wrist diameter of female archers was 4.73 cm with standard deviation 0.330. The male archer had wrist diameter of 5.04 cm with standard deviation 0.329. The female archers had 6.44 cm hand diameter with standard deviation 0.580. The hand diameter of the male archers was 7.14 cm with standard deviation 0.483. The bicondylar femur diameter of female archer was 8.32 cm with standard deviation 0.461. Whereas, the bicondylar femur diameter of male archers was 8.74 cm with standard deviation 0.544. Male archers were found to have significantly greater biacromial diameter ($t=2.503$, $p=0.018$), bicondylar humerus diameter ($t=2.921$, $p=0.007$), wrist diameter ($t=2.545$, $p=0.017$), hand diameter ($t=3.588$, $p=0.001$) and bicondylar femur diameter ($t=2.278$, $p=0.031$) as compared to female archers. The mean and standard deviation of upper arm circumference of female archers were 26.28 and 1.92 respectively. The male archers had upper arm circumference of 26.20 cm with standard deviation 2.12. The forearm circumference of female archers was 22.16 cm with standard deviation 1.56. Whereas, the forearm circumference of male archers was 23.25 cm and standard deviation was 1.92. The mean of wrist circumference of female archers was 16.12 cm with standard deviation 1.67. The male archer had wrist circumference of 16.23 cm with standard deviation 0.797. The female archers had 43.94 cm thigh circumference and had

standard deviation 4.96. The thigh circumference of the male archers was 42.60 cm with standard deviation 5.79. The calf circumference of female archer was 18.46 cm with standard deviation 2.41. Whereas the calf circumference of male archers was 14.14 cm with standard deviation 3.78. There were no significant differences among female and male archers with regard to upper arm, forearm, wrist, thigh and calf circumferences. The mean of biceps skinfold of female archers was 10.98 mm with standard deviation 2.47. The male archers had biceps skinfold of 9.91 mm with standard deviation 3.13. The triceps skinfold of female archers was 14.55 mm with standard deviation 3.86. On the other hand, the triceps skinfold of male archers was 13.26 mm by with standard deviation 3.03. The mean of subscapular skinfold of female archers was 13.74 mm with standard deviation 2.6. The male archer had subscapular skinfold of 13.06 cm with standard deviation 3.05. The female archers had 9.55 mm supra-iliac skinfold with standard deviation 3.54. The supra-iliac skinfold of the male archers was 8.56 mm with standard deviation 2.38. The calf skinfold of female archer was 18.46 mm with standard deviation 2.41. However, the calf skinfold of male archers was 14.14 mm with standard deviation 3.78. Female archers were found to have significantly greater calf skinfold ($t=3.729$, $p=0.001$) as compared to male archers. There were no significant differences among female and male archers with regard to bicep skinfold, triceps skinfold, subscapular skinfold, supra-iliac skinfold. The mean percent fat of female archers was 26.33 with standard deviation 2.31. The male archers had percent fat of 18.77 with standard deviation 1.97. The total body fat of female archers was 15.10 with standard deviation 2.62. Whereas the total body fat of male archers was 10.99 with standard deviation 1.66. The female archers had 42.03 lean body mass with standard deviation 4.36. The lean body mass of the male archers was 47.60 with standard deviation 6.15. There were significant differences among female and male archers with regard to the percent body fat ($t=9.623$, $p=0.000$), total body fat ($t=5.028$, $p=0.000$) and lean body mass ($t=2.862$, $p=0.008$).

Table 2: Relationship of anthropometric characteristics with the performance among the archers

Variable	Female Archers		Male Archers		Combined Group	
	r	p-value	R	p-value	r	p-value
Height(cm)	0.110	0.698	0.014	0.961	0.171	0.366
Weight (kg)	0.318	0.247	0.144	0.608	0.253	0.178
Body Mass Index (kg/m ²)	0.325	0.238	0.174	0.358	0.174	0.358
Arm Length (cm)	0.165	0.558	0.354	0.105	0.100	0.599
Upper Arm Length (cm)	0.177	0.528	0.135	0.632	0.097	0.608
Lower Arm Length(cm)	0.114	0.687	0.234	0.402	0.056	0.771
Hand Length(cm)	0.155	0.581	0.171	0.242	0.104	0.583
Biacromial Diameter (cm)	0.225	0.420	0.178	0.525	0.123	0.516
Bicondylar Humerus Diameter (cm)	0.046	0.871	0.321	0.244	0.001	0.996
Wrist Diameter (cm)	0.114	0.687	0.250	0.368	0.032	0.865
Hand Diameter (cm)	0.071	0.802	0.407	0.132	0.084	0.659
Bicondylar Femur Diameter(cm)	0.160	0.508	0.055	0.845	0.015	0.938
Upper Arm Circumference(cm)	0.163	0.562	0.071	0.801	0.045	0.813
Forearm circumference(cm)	0.171	0.542	0.121	0.667	0.203	0.281
Wrist Circumference(cm)	0.364	0.182	0.003	0.992	0.115	0.547
Thigh Circumference(cm)	0.046	0.870	0.099	0.725	0.048	0.801
Calf Circumference(cm)	0.020	0.943	0.292	0.291	0.122	0.521
Biceps Skinfold(mm)	0.112	0.692	0.259	0.352	0.127	0.505
Triceps Skinfold(mm)	0.084	0.767	0.275	0.322	0.141	0.456
Subscapular Skinfold (mm)	0.348	0.204	0.242	0.386	0.047	0.807
Supra-iliac Skinfold (mm)	0.384	0.158	0.183	0.513	0.006	0.976
Calf Skinfold (mm)	0.201	0.473	0.004	0.988	0.221	0.241
Percent Body Fat (%)	0.283	0.307	0.056	0.843	0.235	0.211
Total Body Fat (kg)	0.108	0.701	0.103	0.715	0.075	0.692
Lean Body Fat (kg)	0.351	0.908	0.152	0.588	0.330	0.075

Table 2 presents the relationship of performance with the anthropometric measurements and body composition components among the female, male and combined group archers. The Karl Pearson's coefficient of correlation revealed that the anthropometric measurements and body composition components did not show any significant relationship with the performance of the male, female and combined group archers.

Discussion

The objective of the study was to evaluate the anthropometric measurements of male and female university level archers and to assess the relationship of anthropometric measurements with the performance score of the archers. The male and female archers were also compared on anthropometric characteristics. There are scant studies on the anthropometric characteristics among the archers in the literature. The findings of the present study, therefore, compared with studies conducted on players of other sports. The findings revealed that the male archers had significantly greater measurements of various body segments as compared to female archers. These results are in conformity with those reported by Sharma^[14] on basketball players. However, female archers had significantly greater values on various body composition components. Similar findings were reported by Sharma^[14] on basketball players. These differences could be explained by the fact that male archers had greater body build whereas female archers had higher body fat. The correlation analysis showed that there were no significant associations between anthropometric characteristics and performance among the archers. These findings are not in line with those reported on baseball and softball players^[15, 16]. There were no significant associations between body composition components and performance among the archers. The excess of fat mass and lack of lean body mass among the players may have a negative effect on the performance. These findings are in line with those reported on baseball and softball players^[16-18]. Studies in different sports showed that the muscle mass have been in a better association to success in sport (maximum aerobic performance, running time, strength etc) than the percentage body fat^[19-22]. On the basis of results of present study, it can be concluded that the anthropometric characteristics and body composition components did not have any association with the performance of archers.

Conclusions

The male archers had significantly greater anthropometric variables viz. height, arm length, lower arm length, biacromial diameter, bicondylar humerus diameter, wrist diameter, hand diameter, bicondylar femur diameter and lean body mass as compared to female archers. The female archers had significantly better calf skinfold, percent body fat and total body fat than the male archers. The anthropometric characteristics did not show any association with the performance among the archers.

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