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## Study of anthropometric characteristics among judokas of different weight categories

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### Abstract

The primary objective of this study was to examine the anthropometric characteristics among the judokas of different weight categories. Total 48 judokas from different districts of Punjab were analyzed on the basis of different weight categories. The judokas falling under the age group of 16-22 years were studied. Height and length measurements of the players were measured with the anthropometric rod. Portable weighing machine was used to measure the weight of the players. Circumferences of the body parts of the players were measured with the steel tape. Diameters of the body parts of the players were assessed with the digital sliding caliper. The one-way ANOVA revealed that there were significant differences in height ( $p < 0.05$ ), arm length ( $p < 0.05$ ), biacromial ( $p < 0.05$ ) and bicondylar femur ( $p < 0.05$ ) diameters, chest ( $p < 0.05$ ), upper arm ( $p < 0.05$ ) and thigh ( $p < 0.05$ ) circumferences among the different weight categories of judokas. The post-hoc analysis showed a linear increase in anthropometric characteristics from light weight judokas to middle weight and heavy weight judokas.

**Keywords:** Body composition, performance, percent body fat, lean body mass, softball

### Introduction

Judo has no strikes and uses no weapons. Competitive judo can be described as a combative, high intensity sport in which the athlete attempts to throw the opponent on his/her back or to control him/her during groundwork combat. Both attempts depend on specific techniques and tactical skills with the support of good physical fitness<sup>[1, 2]</sup>. Judo requires a high physical, physiological, psychological and technical preparation<sup>[3]</sup>. Anthropometrical variables are also considered requisites for high performance in judo competition<sup>[4, 2]</sup>.

Understanding the anthropometric characteristics in every field is an important, determining and influential factor in the performance of athletes. Being aware of these characteristics is important for comparing an athlete's performance to his previous performance and to the performance of other athletes, in addition to finding weaknesses and their removal, and finally deciding on the correct design of exercise programs. Achieving the optimum athletic performance and best position in sport requires athletes who possess special anthropometric characteristics, as well as using scientific exercise programs and having access to sport sciences experts and to enough facilities. Theoretically speaking, being aware of the anthropometric characteristics of an elite athlete will pave the way for his success.

The anthropometric measurements are used to determine the morphological status, that is, body constitution and body structure of an athlete. It is well known fact that a general relationship exist between morphology and performance. Several studies on various body characteristics of different sports activities have been carried out by many researchers and they conclude that strong relationship exist between structure and performance<sup>[5, 6, 7]</sup>. Malina<sup>[8]</sup> speculates that morphological trait during early childhood provide early competitive advantage in to train and compete in a specific sport. Structural features of judo athletes were described by Carter<sup>[9]</sup>, who concluded that elite male judo athletes were heavy for their height. For instance, the male judo athletes competing in the 1976 Olympic Games recorded a reciprocal ponderal index (RPI) of 40.86 cm/kg 0.333<sup>[9]</sup>. It showed that anthropometric characteristics play an important role in performance at higher level in judo. Although there are so many other factors on which the game of judo is depending upon but in the present endeavor this study is undertaken with the aim to evaluate the selected anthropometric measurements of male judokas.

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## Methodology

In the present study, only those judokas were purposively selected as subjects who were with more than 8 years of judo practice, from different districts of Punjab. Total 48 judokas from different districts of Punjab were analyzed on the basis of different weight categories. The judokas falling under the age group of 16-22 years were studied. The judokas were divided into three groups on the basis of different weight categories. The judokas of 50kg to 66kg were considered as 'Light Weight Group', judokas of 66kg to 81kg were considered as 'Middle Weight Group' and judokas above <81kg were considered as 'Heavy Weight Group'.

**Table 1** Division of Judokas as Sample

Sr. No.	Group	No. of Subjects
1.	Light Weight Judokas	17
2.	Middle Weight Judokas	16
3.	Heavy Weight Judokas	15

## Selection of variables

All the anthropometric measurements of all subjects were measured in the morning time and before the practice time. The anthropometric measurements were measured in centimeters scale up to the nearest millimeters. Posture of the subject was checked every time so that a correct measurement could be taken. The anthropometric measurements were taken from the judokas

## Gross Body Measurements

1. Weight (kg)
2. Height (cm)

## Length of Body Parts (cm)

1. Arm Length

2. Leg Length

## Diameters of Body Parts (cm)

1. Biacromial Diameter
2. Bicondylar Femur Diameter
3. Bicondylar Humerus Diameter

## Circumferences of Body Parts (cm)

1. Chest Circumference
2. Upper Arm Circumference
3. Thigh Circumference

The height and length measurements of the judokas were measured with anthropometric rod to the nearest 0.5 cm (HG-72, Nexgen ergonomics, Canada). Portable weighing machine was used to measure the weight of the softball players to the nearest 0.5 kg. Circumferences of the body parts of the players were measured with the steel tape. Diameters of the body parts of the players were assessed with the digital sliding caliper.

## Statistical Analysis

Statistical analysis was performed using SPSS version 16.0 for windows (SPSS Inc, Chicago, IL, USA). All descriptive data was reported as mean and standard deviation. One-way analysis of variance (ANOVA) was employed to test for differences among the three groups of judokas. Following the detection of a significant main effect, Tukey post-hoc analyses were performed to locate where specific mean differences were laid. Significance levels were set at  $p < 0.05$ .

## Results

**Table 2** Comparison of height among the different groups of judokas

Variable	Groups	N	Mean	SD	F-value
Height (cm)	Light weight	17	1.67	6.12	9.80*
	Middle weight	16	1.69	5.46	
	Heavy weight	15	1.78	9.65	
Arm Length (cm)	Light weight	17	76.05	3.71	6.47*
	Middle weight	16	80.65	4.57	
	Heavy weight	15	80.06	3.63	
Leg Length (cm)	Light weight	17	92.00	5.12	2.62
	Middle weight	16	93.06	5.19	
	Heavy weight	15	96.66	7.46	
Biacromial Diameter (mm)	Light weight	17	393.23	22.42	25.01*
	Middle weight	16	420.5	12.95	
	Heavy weight	15	439.26	18.77	
Bicondylar Humerus Diameter (mm)	Light weight	17	65.35	14.21	1.89
	Middle weight	16	71.37	8.53	
	Heavy weight	15	71.26	4.69	
Bicondylar Femur Diameter (mm)	Light weight	17	91.64	6.50	11.41*
	Middle weight	16	98.56	8.26	
	Heavy weight	15	104.0	7.18	
Chest Circumference (cm)	Light weight	17	85.35	4.93	11.51*
	Middle weight	16	102.12	25.69	
	Heavy weight	15	110.86	4.86	
Upper arm Circumference (cm)	Light weight	17	27.11	2.14	50.61*
	Middle weight	16	30.87	2.75	
	Heavy weight	15	35.60	2.19	
Thigh Circumference (cm)	Light weight	17	43.41	6.144	3.97*
	Middle weight	16	51.90	14.86	
	Heavy weight	15	53.06	9.39	

\* indicates  $p < 0.05$

**Table 3** Tukey's post-hoc values of height of different groups of judokas

Anthropometric variable	Mean Difference		
	Light weight vs Middle weight	Light weight vs Heavy weight	Middle weight vs Heavy weight
Height	2.16	10.82*	8.65*
Arm length	4.59*	4.00*	0.58
Biacromial Diameter	27.26*	46.03*	18.76*
Bicondylar Femur Diameter	6.91*	12.35*	5.43
Chest Circumference	16.77*	25.51*	8.74
Upper arm Circumference	3.75*	8.48*	4.72*
Thigh Circumference	8.49	9.65*	1.16

\* indicates  $p < 0.05$

Table-2 depicts the descriptive statistics and one-way analysis of variance (ANOVA) of the selected anthropometric characteristics among different groups of judokas. Significant difference was observed in height of individuals in different groups of judokas ( $F=9.80$ ,  $p<0.001$ ). Heavy weight judokas were tallest and they were followed by middle weight and light weight judokas respectively. Tukey's post-hoc analysis (table-3) revealed that the heavy weight judokas were significantly taller when compared to light weight and middle weight judokas. In relation to arm length, statistically significant difference was observed among the individuals of the different groups of judokas ( $F= 6.47$ ,  $p=0.001$ ). Heavy weight judokas had highest arm length and they were followed by middle weight and light weight judokas respectively. Tukey's post-hoc analysis reported that heavy weight judokas had significantly longer arm length when compared to light weight judokas. Similarly, middle weight judokas were found to have significantly longer arm length as compared to light weight judokas. F-value showed that there was no significant difference in leg length among the different groups of judokas. The heavy weight judokas had the highest leg length with mean value of 96.66 cm and they were followed by middle weight judokas with mean value of 93.06 cm and light weight judokas with mean value of 92 cm respectively. Significant difference was observed in biacromial diameter of individuals in the different weight groups of judokas ( $F=25.01$ ,  $p<0.001$ ). Heavy weight judokas had the widest biacromial diameter and they were followed by middle weight and light weight judokas. Tukey's post-hoc analysis reported that heavy weight judokas had significantly wider biacromial diameter as compared to middle weight and light weight judokas. Similarly, middle weight judokas have significantly wider biacromial diameter as compared to light weight judokas. F-value revealed that there was no significant difference in bicondylar humerus diameter among the different groups of judokas. The middle weight judokas had the highest bicondylar humerus diameter with mean value of 71.37 mm and they were followed by heavy weight judokas with mean value of 71.26 mm and light weight judokas with mean value of 65.35 mm respectively. Statistically significant differences was observed in Bicondylar femur diameter of the individuals of different weight groups of judokas ( $F= 11.41$ ,  $p<0.001$ ). Heavy weight judokas had wider bicondylar femur diameter and they were followed by middle weight and light weight judokas respectively. Tukey's post-hoc analysis revealed that heavy weight judokas were found to have significantly wider bicondylar femur diameter as compared to middle weight and light weight judokas. Similarly, bicondylar femur diameter in middle weight judokas was significantly wider than light weight judokas. In relation to chest circumference statistically significant difference was found

among the different weight groups of judokas ( $F=11.51$ ,  $p<0.001$ ). The heavy weight judokas had the greatest chest circumference and they were followed by middle weight and light weight judokas respectively. Tukey's post-hoc values of the chest circumference. These values revealed that middle weight judokas had greater chest circumference than the light weight judokas. Heavy weight judokas had significantly greater chest circumference when compared to light weight judokas. Upper arm circumference was observed significant among the individuals of different weight groups of judokas ( $F=50.61$ ,  $p<0.001$ ). The upper arm circumference was greatest in heavy weight judokas. This was followed by middle weight, light weight judokas respectively. Tukey's post-hoc analysis reported that heavy weight judokas have greater upper arm circumference as compared to middle weight and light weight judokas. Similarly, middle weight judokas had greater upper arm circumference as compared to light weight judokas. In relation to thigh circumference statistically significant difference was found among the different weight groups of judokas ( $F= 3.97$ ,  $p=0.001$ ). The heavy weight judokas were found to have the greatest thigh circumference and they were followed by the middle weight and light weight judokas respectively. Tukey's post-hoc analysis revealed that heavy weight judokas had significantly greater thigh circumference when compares to light weight.

## Discussion

In the present study the anthropometric characteristics of the judokas have been evaluated in relation to different weight categories. This study indicates the existence of differences in anthropometric characteristics among the judokas of different weight categories. The result of present study showed a linear increase in anthropometric characteristics from light weight judokas to middle weight and heavy weight judokas. These findings are in line with many other studies [2, 10] which compare the weight categories concerning the anthropometric characteristics and they found a linear increase from under 60-kg to 81-90 kg category and a big increase in half-heavy weight (90-100 kg) and heavy weight (more than 100-kg) categories compared to lower categories. The height of the judokas in the present study increases linearly from light weight judokas to middle weight and heavy weight judokas. The height of the heavy weight judokas in the present study is comparable with their international counterparts from Brazil, Belgium, Korea, Japan and America in the same weight categories [1, 10, 11]. Significant differences were reported in the length of upper extremity among the judokas of different weight categories. The middle weight and heavy weight judokas were found have significantly greater arm length as compared to light weight judokas. However, it is important to emphasize that a superior upper extremity length is

considered important to judo performance<sup>[1]</sup> during the period of combat both athletes try to throw and restrain the opponent by holding the collar and sleeve of the judo jacket of the opponent. When a judo player is holding the opponents judo jacket and want to increase his/her distance from the opponent it is necessary to have greater arm length. Therefore the greater arm length is advantageous in judo fight. In case of lower extremity length, there were no significant differences among the different weight categories of the judokas. The result of the present study showed that the biacromial, humerus and femur epicondyles diameters also increased linearly from light weight to middle weight and heavy weight judokas. The various diameter values for heavy weight judokas in the present study were quite similar to those reported before in elite judo players<sup>[1]</sup>. The higher values of various diameters indicates that the judokas in the present study have better bone adaptation to the judo training, which involves many movements such as carrying and pulling the opponent or a better bone structure that allows them to withstand the training stress.

### Conclusion

In conclusion, it was observed that there were significantly differences in height, arm length, biacromial and bicondylar femur diameters, chest, upper arm and thigh circumferences among the different weight categories of judokas. There was a linear increase in anthropometric characteristics from light weight judokas to middle weight and heavy weight judokas.

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