

## Body composition and aerobic capacity of judokas and controls: A comparative study

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### Abstract

**Introduction:** Anthropometric parameters of judo players play an important role for success in combats. Aerobic capacity is significant in terms of optimal use of the judoka's system and timely recovery process. Study was undertaken with objective to compare body build and aerobic capacity of judokas with untrained peers and understand changes in judokas due to training.

**Materials and Methods:** Judo players (n=31) with minimum 3 years of training and who were in regular practice were included and compared with age matched medical students (n=31). Students who practice regular exercise regime were excluded. Anthropometric parameters were measured in terms of weight, height body mass index, seven site body circumferences, seven site skin fold thickness. Body fat percentage was further calculated as per standard formula. VO<sub>2</sub>max or the aerobic capacity was determined by using treadmill and following Bruce protocol.

**Results and Discussion:** Control group showed significantly higher values for Skinfold thickness, body density and body fat % than judo group. Mean value of circumference of upper limb was more in judo players group. VO<sub>2</sub>max was more for Judo group 63.9ml/ kg/ min, than control 48.9ml/kg/min.

**Conclusion:** The results of the study can be utilised as a means to understand the different physiological changes due to training in a player and also to optimise and upgrade the training regime so as to achieve best performance in the judo players.

**Keywords:** Judo, VO<sub>2</sub>Max, Anthropometry, Body fat, Skinfold thickness.

### Introduction

Judo is considered as aggressive, high intensity sport in which the player try to throw the opponent onto his back or to dominate him during groundwork combat. Both of these skills are dependent on specific tactics and techniques with the foundation of good physical fitness.<sup>1</sup> Elite high level judo players have low body fat as judo is one of the weight-classified sport. Studies propose that body fat percentage can be a discriminator for success.<sup>1</sup> Therefore, Anthropometric profile of judokas is a relevant factor for success in competition and performance in specific judo tests.<sup>2</sup>

In Judo movements are swift and powerful that require both the pathways aerobic and anaerobic alternatively for supply of energy. A judo battle typically have short intense muscular activity for 15 to 30 seconds when anaerobic system is involved, whereas the entire duration of battle is more than five minutes and aerobic metabolic pathway is active particularly near the end of the combat.<sup>3</sup> The maximum oxygen uptake or VO<sub>2</sub>max estimation is considered as an useful tool of cardiovascular endurance to assess the person's ability to maintain high-intensity exercise for more than five minutes.<sup>4</sup>

As all pathways of energy are used by judo players in a combat, bearing in mind the duration of each contest and the total number of such contest in a given tournament, Aerobic capacity is significant in terms of optimal use of the judoka's system and timely recovery process.<sup>5</sup>

Comparison of indicators of aerobic capacity and morphological body build in judo contestants to the untrained should allow to identify the changes or effect of

training on the predictors and to formulate techniques for further development. Based on this comparison, it will be possible to draw indirect conclusions about the rate of transformations and the level of these indices in particular study age groups. So this study was planned with objective to compare body build and aerobic capacity of judokas with untrained peers.

### Materials and Methods

Sample size based on universal sampling all the Judo players in age group of 18-25yrs of the city with regular practice for a minimum period of 3 years were included n=31. For comparison, age (18-25yrs) matched first year medical students admitted for the academic year were enrolled as controls. Students with regular practice were excluded. Selection was done using random number table. Participants of both groups were briefed about the study and written informed consent was obtained. Information about the age of the participant, medical history, habits was obtained. Player group details regarding duration of judo practice, hours of practice every day, dietary habits was collected by interviewing the players.

**Methodology:** Physical anthropological indices<sup>6,7</sup> Height (cm) was measured by Commercial stadiometer. Weight (kg) was noted by Digital scale with an accuracy of  $\pm 100$ gm. BMI was calculated from height and weight using Quetelet's equation.

**BMI** = body weight in Kg / (height in meters)<sup>2</sup>

Skin fold thickness (mm) was measured by Herpenden skin fold calipers (Anand agencies, Pune). Seven sites were identified and readings were taken on the right side of the

body (Triceps, Midaxillary, Subscapular, Abdomen, Thigh, Suprailiac, and Medial calf). Mean of two readings were considered.

Body density Calculated by sum of seven site skinfolds thickness formula.

For men  $1.112 - 0.00043499 (\text{sum of seven skinfolds}) + 0.00000055 (\text{sum of seven skinfolds})^2 - 0.00028826 (\text{age})$ .

For women  $1.097 - 0.00046971 (\text{sum of seven skinfolds}) + 0.00000056 (\text{sum of seven skinfolds})^2 - 0.00012828 (\text{age})$ .

Body fat % was computed using

Siri's Equation  $4.950 - 4.500 \times 100$

Body density

**Circumferences (cms)** were measured in by measuring tape. Seven sites were identified (Flexed arm, relaxed arm, forearm, wrist, chest, thigh and calf) and measured as per standard protocol.<sup>8</sup>

Cardiorespiratory endurance was assessed by calculating  $\text{VO}_{2\text{max}}$  (maximum oxygen uptake) by motor driven treadmill using Bruce protocol. Exercise was carried out on a treadmill, the test started at speed of 2.74 km/hr and at a inclination of 10%. After every three minute interval the inclination of the treadmill was increased by 2%, and the speed increased as per the protocol. Subject was informed to perform to maximum exertion and to inform at exhaustion. Total Time taken on the test, in minutes was taken as Test Score. This test score is converted to  $\text{VO}_{2\text{max}}$  score using following formulas, where "T" is the total time completed expressed in minutes and fractions of a minute.

$\text{VO}_{2\text{max}} (\text{ml} / \text{kg} / \text{min}) = 14.76 - (1.379 \times T) + (0.451 \times T^2) - (0.012 \times T^3)$

**Table 1: Anthropometric variables of Judo and control group**

| Anthropometric Variables        | JUDO Group    | Control group | p Value |
|---------------------------------|---------------|---------------|---------|
| Age (yrs)                       | 20.1 ± 1.55   | 18.7 ± 0.78   | 0.000*  |
| Height (cms)                    | 163.9 ± 11.25 | 168.6 ± 9.93  | 0.087   |
| Weight (kg)                     | 61.1 ± 9.56   | 63.3 ± 9.51   | 0.368   |
| BMI                             | 23 ± 3.31     | 22.3 ± 2.65   | 0.377   |
| Sum of Skin fold thickness (mm) | 77.3 ± 20.09  | 114 ± 33.22   | 0.000*  |
| Body density                    | 1.06 ± 0.01   | 1.05 ± 0.01   | 0.000*  |
| Body fat %                      | 12.6 ± 5.90   | 17.5 ± 4.73   | 0.001*  |

(\*) p value significance < 0.05

**Table 2: Circumferences (cm) of Judo and Control group**

|             | Judo        | Control     | p value |
|-------------|-------------|-------------|---------|
| Relaxed arm | 28.3 ± 2.12 | 26.6 ± 2.65 | 0.006 * |
| Flexed arm  | 31.4 ± 2.28 | 29 ± 2.87   | 0.001 * |
| Fore arm    | 25.3 ± 1.84 | 23.8 ± 1.89 | 0.002 * |
| Wrist       | 16.8 ± 0.89 | 16.2 ± 1.25 | 0.029 * |
| Thigh       | 48.4 ± 3.97 | 46.6 ± 5.45 | 0.149   |
| Calf        | 34.4 ± 2.69 | 34.8 ± 3.41 | 0.627   |
| Chest       | 88.5 ± 6.56 | 86.7 ± 6.56 | 0.254   |

(\*) p value significance < 0.05

## Statistical Analysis

All the parameters were represented as mean and standard deviation. Students unpaired 't' test was used to test the difference between mean of the two groups, where p value was < 0.05 was taken as significant.

## Results

**Anthropometric data of the participants** Mean age of players in judo group was 20.1 whereas in control group it was 18.7 years with statistically significant (p<0.05) difference. Mean height, weight and body mass index did not show any significant (p>0.05) difference between both the groups. Mean of Sum of seven skinfold thickness, body density and body fat % was significantly more in control group. (p <0.05) as shown in Table 1. Mean of the upper limb circumference measurement- arm relaxed, flexed, forearm, and wrist more in judo group with statistically significant (p<0.05) (Table 2). Mean of all skinfold thickness was comparatively high for control group than judo group and the difference was significant statistically (p <0.05) (Table 3).

**Cardiorespiratory fitness of judo and controls** (Table 4) summarize the cardiorespiratory fitness between judo players and controls. Distance covered and total test time on treadmill test was more for judo group and the difference was statistically significant (p<0.05).  $\text{VO}_{2\text{max}}$  was more for Judo group 63.9ml/ kg/ min, than control 48.9ml/kg/min with statistically significant difference (p<0.05).

**Table 3: Skin fold thickness (mm) of Judo and Control group**

|                | <b>Judo</b> | <b>Control</b> | <b>p value</b> |
|----------------|-------------|----------------|----------------|
| Triceps        | 10.2 ± 3.49 | 15.8 ± 4.02    | 0.000 *        |
| Subscapular    | 10.8 ± 3.17 | 15.6 ± 4.02    | 0.000 *        |
| Midaxillary    | 9.8 ± 3.15  | 13.8 ± 4.49    | 0.000 *        |
| Abdomen        | 10.8 ± 4.01 | 16.6 ± 6.71    | 0.000 *        |
| Suprailiac     | 10.6 ± 3.49 | 15.6 ± 6.81    | 0.001 *        |
| Proximal thigh | 12.5 ± 3.49 | 19.3 ± 8.29    | 0.000 *        |
| Medial calf    | 12.1 ± 3.40 | 17.2 ± 6.31    | 0.000 *        |

(\*) p value significance < 0.05

**Table 4: Cardiorespiratory fitness of Judo and Controls**

|                                    | <b>Judo</b>  | <b>Control</b> | <b>p Value</b> |
|------------------------------------|--------------|----------------|----------------|
| Distance covered Km/hr             | 2.98 ± 0.78  | 1.25 ± 0.54    | 0.000*         |
| Total test time on treadmill (min) | 26.9 ± 5.67  | 13.6 ± 3.14    | 0.000*         |
| VO <sub>2max</sub> (ml/kg/min)     | 63.9 ± 11.68 | 48.9 ± 11.88   | 0.000*         |

(\*) p value significance < 0.05

## Discussion

In this present study, there was no significant difference between weight, height and BMI in the two groups. One study demonstrated that BMI levels are greater in athletes, which results from higher fat-free mass. Hence, in the case of contestants, BMI has a limited diagnostic value. In sports with weight classes, nearly 76% of competitors are subjected to body mass reduction before major competitions.<sup>9</sup>

When compared with controls players had less fat % indicates that judo players were lean, this supports the statement that judo players try to reduce fat mass and amplify lean body mass by training techniques. It just reflects on physiological adaptations to long-term judo training.<sup>10-13</sup> Previous studies gives the body fat percentage values of different judo players as follows: Brazilian team (13.7%), Canadian team (12.3%), Hungarian team (8.9%), Japanese (16.2%), and North American team (8.3%).<sup>14</sup> Our value was (12.6%).

Body Circumferences mainly the upper segment (arm and forearm) were considerably higher for judo group than controls which is the basic requirement for the game and the development may be due to the muscular hypertrophy as a result of training. The sum of thickness of skinfold at all the seven sites was very much more in controls than judo players indicating the greater amount of subcutaneous fat among the controls. These anthropometric values indicate that the judo players maintain lean body when compared to the normal, sedentary, non-exercising controls.

Cardiorespiratory endurance is the ability to carry out continued forceful activity using large muscle groups or It is the capacity of the circulatory and respiratory systems to adjust and recuperate from the effects of exercise or Ability of the body to supply oxygen efficiently to the working muscles to do physical activity. A person's VO<sub>2max</sub>. is his maximum capacity to use oxygen.

In the treadmill test carried out on both the groups shows that player group could cover more distance before exhaustion indicating that the trained players could maintain

their stamina for longer time hence, delaying fatigue. Mean Maximum oxygen consumption (VO<sub>2max</sub>) was found to be high for players (63.9 ml/kg/min) than for controls (48.9 ml/kg/min) suggesting better aerobic capacity or ability to utilize oxygen in trained group, this is attributed to the effect of training which causes greater increase in cardiac output (which is in turn due to low resting heart rate and high stroke volume) and increase in arteriovenous O<sub>2</sub> difference.<sup>15</sup>

In contrast to our study Analysis of the results for VO<sub>2max</sub> in judoists (41.9 ml · kg<sup>-1</sup> · min<sup>-1</sup>), did not differ from the results obtained for the untrained controls (39.8 ml · kg<sup>-1</sup> · min<sup>-1</sup>) gives the impression that this indicator is not a leading predictor which would determine sport performance level.<sup>9</sup> The aim of aerobic processes in judo is to prepare the functional capacity of the heart and ability of blood circulation to transport the oxygen to muscles, which will have an effect on the improvements in bringing the oxygen through continuous training. Research indicates that 15–20% increase in VO<sub>2max</sub> can be achieved by aerobic training. Endurance training causes increase in beta oxidation enzymes, glycolytic enzymes and citrate synthetase in the TCA cycle. These physiological changes facilitate maximum use of fatty acids through beta oxidation for energy, so glycogen demand is reduced and it is spared. Hence time taken for fatigue during exercise is prolonged. Aerobic conditioning sessions helps in better recovery from anaerobic exertion.<sup>6</sup> Research has indicated individuals with aerobic training can work at 75-85% of their aerobic power before facing fatigue. Judo player essentially should have a good aerobic support or working capacity which can be developed through the nature of a typical competition practice. This study will definitely help the players to enhance performance. Limitation of the study – we were not able to analyse the differences between male and female participants for the above said parameters in our study.

## Conclusion

Developing sport specific abilities that affect the result is important in training process, the present findings may be effectively used by coaches and players to appreciate the changes that take place in anthropometry and aerobic capacity of judo players due to training and also as a tool to standardise the training programs so as to achieve best results from the judoka.

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**Authorship Declaration:** Both the authors were involved in conception, design, data collection, analysis, interpretation of data and in drafting the article.

**Conflict of Interest:** None.

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