



# Effectiveness of physiotherapy exercises on grip strength, muscular endurance, and aerobic performance in Indian judo players

Ujwal Laxman Yeole, Sneha Santosh Naikoji<sup>1</sup>

## Abstract:

**BACKGROUND:** The judo is the dynamic, high-intensity intermittent sport which needs advanced skills and military science excellence for fulfillment. Throughout the judo combat, strength and muscle power are associated with performance and judo-throw potency; therefore, the study aims to analyze the effect of physiotherapy exercises on grip strength, aerobic performance, and muscular endurance in Indian judo players.

**MATERIALS AND METHODS:** An experimental study design was used. The study participants were divided into two groups: Group A ( $n = 15$ ) received physiotherapy exercises of grip strength training, muscular endurance training, and aerobic training for 3 days/week for 6 weeks and Group B ( $n = 15$ ) received the conventional exercise program. Pre- and posttreatment analysis was recorded and statistically analyzed.

**RESULTS:** A total of thirty players were recruited for the study. The grip strength of Group A improved from 13.98 to 19.28 (0.0001) for the dominant hand and from 10.66 to 16.26 (0.0001) for nondominant hand as compared to Group B from 12.92 to 13.59 (0.270) for the dominant hand and from 10.45 to 11.34 (0.135) for nondominant hand. The muscular endurance for sit-ups and push-ups of Group A improved from 10.2 to 17.2 (0.0001) and 13.47 to 19.93 (0.0001), respectively, as compared to Group B whose values were 9–10.13 (0.091) and 11.67–12.53 (0.155), respectively. The aerobic performance of Group A improved from 40.91 to 47.31 (0.0001) as compared to Group B from 39.26 to 40.16 (0.222).

**CONCLUSION:** Physiotherapy exercises are effective for improvement in grip strength, aerobic performance, and muscular endurance among Indian judo players.

## Keywords:

Aerobic performance, grip strength, judo players, muscular endurance

## Introduction

Judo was originally invented in 1882 by Dr. Jigoro Kano as a physical, mental, and ethical pedagogy in Japan. It is usually classified as a contemporary, self-protection, and modern martial art that evolved into a combat and Olympic sport. The judo is the dynamic, high-intensity intermittent sport that needs advanced

skills and military science excellence for success.<sup>[1]</sup>

Competitive judo is represented as a multijoint and high-intensity movement discipline, within which specific throwing techniques need a good physical fitness.<sup>[2]</sup> To be effective, judo techniques have to be applied with accuracy, at intervals a decent “window of opportunity,” with strength, speed, and power. This short burst of energy is equipped primarily by anaerobic metabolism. In

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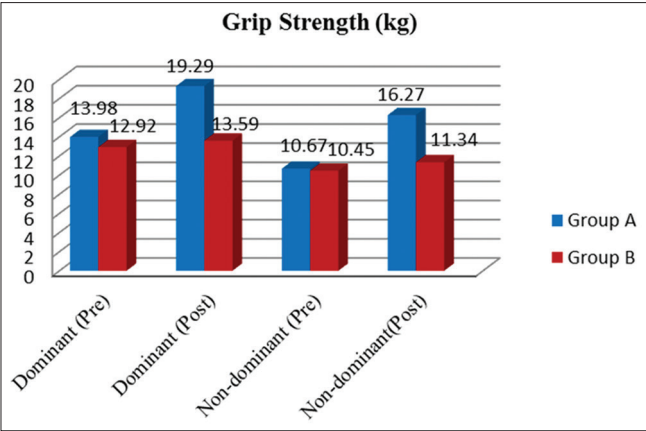
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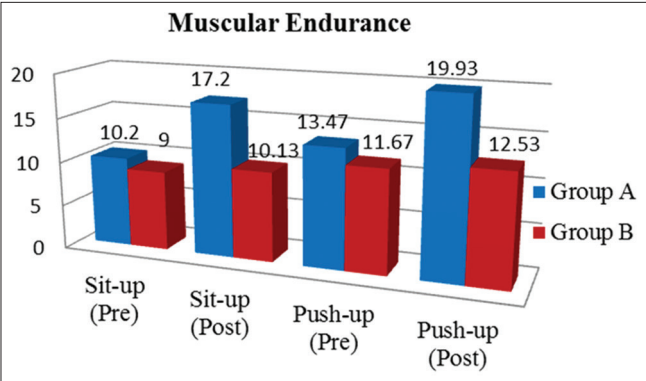
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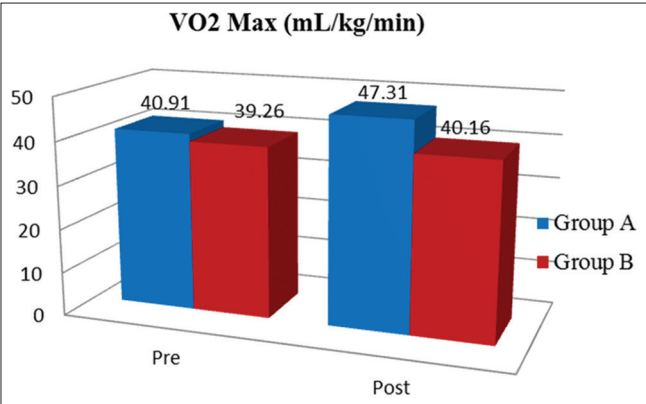
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**Figure 1:** Comparison of grip strength pre- and post-interventions. Interpretation: the Grip strength of Group A improved from  $13.98 \pm 4.9$  to  $19.28 \pm 5.9$  for dominant hand and from  $10.66 \pm 4.4$  to  $16.26 \pm 5.3$  for nondominant hand as compared to Group B from  $12.92 \pm 2.4$  to  $13.59 \pm 3.4$  for dominant hand and from  $10.45 \pm 4.5$  to  $11.34 \pm 3.9$  for nondominant hand with  $P < 0.001$



**Figure 2:** Comparison of muscular endurance pre- and post-intervention. Interpretation: the muscular endurance for sit-ups and push-ups of Group A improved from  $10.2 \pm 4.17$  to  $17.2 \pm 4.9$  and  $13.47 \pm 4.19$  to  $19.93 \pm 4.79$ , respectively, as compared to Group B whose values were  $9 \pm 4.17$  to  $10.13 \pm 2.9$  and  $11.67 \pm 2.6$  to  $12.53 \pm 3.2$ , respectively,  $P < 0.001$



**Figure 3:** Comparison of aerobic performance pre- and post-intervention. Interpretation: the aerobic performance of Group A improved from  $40.91 \pm 7.3$  to  $47.31 \pm 7.2$  as compared to Group B  $39.26 \pm 7.3$  to  $40.16 \pm 5.9$ ,  $P < 0.001$

distinction, the maintenance of the intermittent work performed throughout a match, moreover, over because the recovery method throughout the short intervals, are

**Table 1: Details of players pre- and post-intervention**

Outcome measures	Mean±SD		P
	Group A	Group B	
Demographic data			
Gender			
Males	7	10	
Females	8	5	
Age (years)	10.9±2.25	10.4±1.72	0.395
Height (cm)	129.7±9.3	126.4±9.7	0.296
Weight (kg)	32.8±9.7	31.3±5.6	0.587
Years of practice	1.8±0.93	1.7±0.61	0.524
Grip strength (kg)			
Dominant hand			
Pre	13.98±4.9	12.92±2.4	0.327
Post	19.29±5.9	13.59±3.4	
P	0.0001	0.270	
Nondominant hand			
Pre	10.67±4.4	10.45±4.4	0.811
Post	16.27±5.3	11.34±3.9	
P	0.0001	0.135	
Muscular endurance			
Sit-up			
Pre	10.2±4.17	9±4.17	0.403
Post	17.2±4.09	10.13±2.9	
P	0.0001	0.091	
Push-up			
Pre	13.47±4.19	11.67±2.6	0.205
Post	19.93±4.79	12.53±3.2	
P	0.0001	0.155	
Aerobic performance (ml/kg/min)			
VO <sub>2</sub> max			
Pre	40.91±7.3	39.26±7.3	0.361
Post	47.31±7.2	40.16±5.9	
P	0.0001	0.222	

SD: Standard deviation

primarily supported by aerobic metabolism. To boot, aerobic metabolism is particularly important for a good recovery between matches. With these facts, it will be established that judo could be advanced sport with demands comprising a variety of specific characteristics to reach a high level in competition.<sup>[1]</sup>

During judo combat, strength and muscle power are associated with performance and judo-throw potency. Previous analysis has shown that lower limb muscle power could be determinant of the number of throws performed in judo, and it is associated with the share of win during the male judo European World Cup competitions. Once a judoka executes a range of judo throwing techniques (e.g., seoi-nage, o-goshi, koshi-guruma), power is optimized by muscle-elastic mechanisms, such as the stretch-shortening cycle, and leads to a rise of movement potency.<sup>[3]</sup>

Upper limb strength is another vital facet throughout judo performance, primarily throughout grip

combat (kumi-kata) to attack, defend, and maintain balance. The constant dynamic changes of combat need athletes to use a mixture of maximum strength and endurance throughout kumi-kata, largely to manage the distance between a judoka and his/her opponent.<sup>[3]</sup>

**AQ3** The ability to produce maximum strength or the speed of force development is another elementary action throughout grip combat, moreover because the ability to keep the strength for a longer period of time, since the time of any given match will be up to 5 min or more (golden score). Moreover, judo is an additional option of nonstanding combat (Ne-Waza), which often takes places once a judoka desires to use a chokehold, associate arm lock or different types of immobilizing associate opponent; in these types of situations, maximum strength and muscular endurance are implausibly vital for thriving judo performance.<sup>[3]</sup> Although decisive actions in judo are primarily smitten by anaerobic metabolism, aerobic fitness appears to be vital in high-intensity intermittent exercise, which is the case with judo, because it permits higher recovery throughout the short rest periods between efforts.

The aerobic fitness of judo players has been assessed basically through maximum oxygen uptake ( $VO_2$  max) or peak oxygen uptake ( $VO_2$  peak) for the aerobic power component and **AQ4** **AQ3** via thus referred to as anaerobic threshold for the aerobic capability part. Each aerobic power and capability part thought of relevant to judo performance as a result of its been hypothesized that a higher value for these variables should allow judo athletes to maintain a higher intensity throughout the match, delay the buildup of metabolites related to fatigue processes (e.g., H<sup>+</sup> and K<sup>+</sup>), and improve the recovery method between two consecutive matches.<sup>[1]</sup>

It is accepted that understanding the characteristics of elite athletes can provide insightful information regarding what is needed for competitive success. From a physical conditioning perspective, the goal of giving physiotherapy training is to prepare judo competitors to effectively manage both the physical activity and the physiological demands of combat. **AQ3** It is, therefore, important that coaches and physiotherapists to collect objective information about the players' physical performance and capabilities to substantiate the objectives of physiotherapy training establish short- and long-term physiotherapy exercise protocol, provide objective feedback and to motivate athletes during exercise.

## Materials and Methods

An experimental study was done on thirty players. Participants with playing for more than 1 year, both

males and females between the ages of 8 and 18 years, were selected. Participants who are having recent injuries, intermittent practice, and involved in other sports along with judo were excluded from the study. Permission was taken from the Institutional Ethical Committee of Department of Physiotherapy, Tilak Maharashtra Vidyapeeth. The aim and methodology of the study were explained to them, and their consent was taken. The players were recruited from Judo sports club, different sports clubs were approached, and permission was obtained before the study. Demographic data of the participants were documented. Participants were divided into two groups: Group A is the experimental group which received physiotherapy exercises of grip strength training, muscular endurance training, and aerobic training, and Group B is the control group received conventional exercises.

Pretreatment grip strength, muscular endurance, and aerobic performance were assessed. A hand dynamometer was used to determine the grip strength. The dynamometer was set in line with the hand measurement of the player and by applying the grip strength with no elbow flexion. The participant performed accurately three times, and the maximum reading out of three was taken. Push-up and sit-up test was performed for muscular endurance, and pre- and post-heart rate and respiratory rate were taken during YMCA 3-min step test.

The participants of the experimental group had undergone physiotherapy exercise program for 6 weeks with 30–40 min/session and three sessions per week. These exercises included warm-up 10 min (active range of motion exercises, squatting),<sup>[4]</sup> aerobic training 20 min (sprint running, cycle ergometer, stairstepping, step touch, and skipping),<sup>[5,6]</sup> grip strength training 5 min (clinch fist tightly, squeeze ball, and wrap a rubber around the hand),<sup>[4]</sup> and muscular endurance training 5 min (sit-ups and push-ups with 60% 1RM).<sup>[6]</sup> After every 2 weeks of participation, the progression of exercise was done for grip strength, and the duration of exercise was improved. For muscular endurance, the intensity of exercise was improved by calculating 70% and 80% of 1RM, and for aerobic performance, the duration and intensity of exercises were improved. The conventional exercises given to the control group were sets of low-impact isometric exercises and walking and jogging exercises. Cooldown involved upper and lower body stretching exercises for both groups.<sup>[6]</sup> Posttreatment grip strength, aerobic performance, and muscular endurance were assessed, and the data were collected, and statistical analysis was done.

## Statistics

The analyzed data showed that it was not a normal distribution using Shapiro–Wilk test; hence,

nonparametric test such as Wilcoxon sign-rank test (pair *t*-test) was performed to analyze the data within the groups and Mann–Whitney rank-sum test (unpaired *t*-test) was used to analyze the data between the groups.

### Ethical approval

After seeking permission from the Institutional Research Review Committee of Department of Physiotherapy, Tilak Maharashtra Vidyapeeth, Pune, ethical clearance was obtained.

## Discussion

The judo is the dynamic, high-intensity intermittent sport that needs advanced skills and military science excellence for success.<sup>[1]</sup>

The ability to develop a strong grip and maintain it during a judo match has become a vital component for judo athletes. The synergistic action of flexor and extensor muscles and the interplay of muscle groups is a vital think about the strength of ensuring grip.<sup>[7]</sup> The present study showed improvement in grip strength from pre- to post-intervention. This group underwent exercise program that included clinching fist tightly, squeezing ball, rubber band exercises, and foam grip strengthener exercises. The impact of strengthening exercise on a muscle or muscle group is lifting, lowering, or controlling resistance for a comparatively low number of repetitions or over a brief amount of time. **Therefore, muscle adapts to significant resistance that increases the maximum force capacity produced by muscle, that is, improve in muscle strength, primarily because the result of neural adaptations, and improve in muscle fiber size, thus increasing the muscle strength.**<sup>[4]</sup>

In our study, we also found that grip strength of the dominant hand was more than nondominant hand. A similar result was seen in a study done by Nurgul Arinci Incel and Esma Ceceli, in which they concluded that the dominant hand is remarkably stronger in right-handed people, but no such remarkable difference between sides could be documented for left-handed people. This difference may be attributed to the fact that left-handed people are temporarily forced to use their nondominant hands for daily activities in this right-hand dominant world.<sup>[7]</sup>

In comparison, the muscular endurance of Group A showed a significant improvement as compared to Group B. This group underwent exercise program that included holding the sit-up and push-up position for 12 times with three repetitions of each exercise, respectively. Sit-up and push-up exercises are generally done for muscular endurance. Endurance exercise causes low-intensity muscle contractions,

a large number of repetitions, for a prolonged time period due to strength training, muscles adapt to endurance training by increases in their oxidative and metabolic capacities, and then which they allow better delivery and use of oxygen. Endurance training has a more positive impact on improving function and endurance than strength training. In addition, using low levels of resistance in an exercise program minimizes adverse forces on joints, produces less irritation to soft tissues, and is lighter than heavy significant resistance training, thus improving muscle endurance.<sup>[4]</sup>

Furthermore, Group A underwent exercise program that included sprint running, cycle ergometer, stairstepping, step touch, and skipping exercises. There was a change in values from pre- to post-intervention showing improvement in aerobic capacity, which reflects improved potency of the steps in the oxygen transport pathway to adapt to increased oxygen demands imposed by exercise stress. Their adaptation is effected by both central and peripheral changes. Such aerobic conditioning exercises are characterized by an increased stroke volume and increased oxygen extraction capacity of the working muscle. These adaptations result in an increased maximal oxygen uptake that is  $\text{VO}_2 \text{ max}$ .<sup>[8]</sup>

Escobar Molina, Raquel reported that aerobic capacity enables the fighter to support a high volume of technical-tactical training and accelerates recovery because fatigue is a limiting factor for performance and therefore determines success in the judo combat.<sup>[9]</sup>

## Conclusion

It is concluded that physiotherapy exercise program showed a significant improvement in grip strength, muscular endurance, and aerobic capacity measured through a hand dynamometer and YMCA 3-min step test in judo players.

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### Conflicts of interest

There are no conflicts of interest.



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