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A COMPARATIVE STUDY OF BIO-MOTOR AND PHYSIOLOGICAL VARIABLES FOR HIGH AND LOW PERFORMANCE JUDOKAS

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ABSTRACT

The purpose of this research was to determine whether bio-motor (hand grip strength, back strength, and explosive strength) and physiological (body composition, vital capacity, and resting heart rate) characteristics are the most predictive of future success. Twenty male judokas (N=20) in the 66 kg weight category were chosen from the intercollegiate circuit in Delhi, Madhya Pradesh, Uttar Pradesh, and Uttarakhand. The participant's age was reported to be between 18 and 25. There were twenty participants total, ten each from the high performance (N1=10) and poor performance (N2=10) groups. IBM SPSS 20.0 was used to conduct an independent samples test to assess whether or not there was a statistically sig. diff. between the high- and low-performing groups. In comparison to physiological factors, the research indicated that some bio-motor variables were significantly discriminatory.

Key Words- Judokas, Bio-motor, Physiological and Discriminating

INTRODUCTION

Judo is derived from two Japanese terms, "Ju" and "do," where “Ju” alludes to gentleness and “do” to the way; hence, judo means "giving way in a gentle manner" or "a gentle method." Judo is a fast-paced fighting sport that requires both physical and mental strength. Judo is much more than just knowing how to use fighting techniques. It's a fantastic blend of physical, intellectual, and moral instruction. Judo has its own culture, institutions, history, traditions, and customs. Furthermore, the concepts of gentleness are carried over from the practice mats to judokas' everyday lives. Judo instills a code of ethics and a manner of life in its students. Judo is world famous, with the International Judo Federation having the most members. Many nations include it in the curriculum of professional physical education courses, and it is also performed in local clubs, high schools, universities, and national training centres.(Yoffie David B. and Kwak Mary, 2001)

Judo's goal is to maximise the use of physical and mental power in a variety of ways. Through the mental and physical skills of both attack and defence, judo training and coaching may help you comprehend the real meaning of life. Judo originated as a style of unarmed fighting known as "Jujitsu." Judo combines a code of competitiveness, a sense of mutual

reverence, and a set of ethics and morals that help its practitioners become better people. The art and science of jujitsu go hand in hand. Judo is an art that teaches self-respect, self-confidence, and self-expression to its practitioners, and it is a science that includes fundamental laws such as gravity, friction, momentum, weight transfer, and force summation.(Kano Jigoro, 1956)

Judo and Bio-motor abilities

High degrees of grip, trunk, and lower body strength and power are necessary for judoka. This sets high level Judoka apart from the sub-elite. Lower back and lower body strength and power should be the main targets of strength training. As a result, children and teenagers' training progress is tracked and quantified using neuromuscular tests including handgrip strength and vertical and standing long jump tests. The “Special Judo Fitness Test” (SJFT) and the “Judogi Grip Strength Test” (JGST) are two examples of physical tests that have been employed as markers of judo-specific performance due to the difficulty of getting a single marker of performance during judo bouts. Indirect estimation of anaerobic and aerobic capabilities, and upper-body strength-endurance, are best accomplished using the SJFT and JGST, respectively. The SJFT and JGST have been tested on a variety of judo players across age ranges and sexes, demonstrating their ability to distinguish between top-level and amateur competitors. Previous research has examined the connection between neuromuscular performance and judo-specific tests (SJFT and JGST) in adult judo players, but the same connection between these variables in young athletes is unclear. Monitoring training effects throughout the season is essential, particularly in young athletes, and doing so requires determining the extent to which physical capability may explain the judo-specific performance.(Kons et al., 2020)

Judo and Physiological Variables

Athletes use their respiratory muscles to perform hard while inhaling and exhaling hundreds of times per minute. Studies undertaken unmistakably demonstrate that judokas' performances are positively affected both acutely and chronically by high respiratory function and respiratory muscle strength values. Objective measurements of respiratory functions and respiratory muscle power are possible, and average values for branches may be discovered together with physiological traits for athletes, healthy people, and sick.(ErmiŞ et al., 2019)

Judokas should, ideally, choose the weight class that is appropriate for their height and physique. In any event, a large portion of them often engage in severe weight loss via calorie restriction in order to choose a lower weight class and, in turn, to get an advantage over other judokas in that weight class. Many participants suffer extreme dietary restriction, especially in the week before to the challenge, in order to reach the weight that would allow them to participate in a certain class. The amount of weight loss is then reversed when the participants compensate for the sustained energy expenditure by overindulging in food during the post-competition period. "Weight cycling" is the term used to describe this rapid transition between weight loss and recovery. revealed that 80% of judokas underwent sudden weight drops, prompting the need to investigate the importance of maintaining weight in judo. According to

sex and weight categorization, Ebine et al. described the anthropometric parameters and weight of high-level judokas. Basic estimates like weight and the percentage of muscle to fat might vary depending on factors including sex, age, weight class, and preparation. It has been shown that first class female judokas have a muscle to fat ratio that is around 10% greater than that of first-class male judokas. An analysis revealed that male judokas had higher rates and highest estimates of bulk, larger borders and bone widths, lower endomorphic and higher mesomorphic parts, and were heavier, taller, and had lower muscle against fat ratios than female judokas.(Monika Goswami and Dr. Vivek Chaudhary, 2015) To the observation of the high impact limit and exercise force, the assessment of the pulse's (HR) very still (HRrest submaximal and maximum powers (HRmax) is added. Male judokas' HRrest ranged from 54 to 65 bpm, which was a little lower than that of female judokas (65 to 71 bpm). The use of anaerobic lactic metabolism in coordinated instructions is supported by high blood lactate concentrations, which are typical for irregular actions during wars. The goal of this experiment was to compare the pulse between the light and significant classes in order to gauge the intensity of action in the Judo combat. Five guys judokas from an aggressive group, aged 20.6 to 5.4 years, weighing 87.9 to 24.1 kg. At the very least, each contender engaged in combat with an opponent in their weight class and another in a different class. The combat lasted for five minutes, and a pulse screen was used to assess the pulse at intervals of one instant. In each of the conflicts between the two classes, the pulse often exceeded 160 bpm (the anaerobic zone). Overall, the findings demonstrate the power of anaerobic digestion in judo, which is demonstrated by high heart rates during fights, with no distinction between the light and overwhelming classes every three seconds, nage-komi every three seconds during one minute and thirty seconds, uchikomi once every four seconds, and nage-komi every four seconds during one minute and thirty seconds. Additionally, Franchini et al. evaluated the presentation and physiological responses in discontinuous preparation of uchikomi in a subsequent publication. They found that the HR was 183 bpm during execution and 95 bpm during rest, with lower values seen in the first minute compared to the second and third moments. (Monika Goswami and Dr. Vivek Chaudhary, 2015)

AIM OF THE STUDY

In this comparative study, high performing judokas and low performing judokas were compared basis of selected bio-motor and physiological variables. Other sub-objective of the study was identify which of the selected variable discriminates performance the most.

MATERIAL AND METHOD

Selection of Subject

For the purpose of the study twenty male (N=20) judokas of 66 kg weight category from Delhi, Madhya Pradesh, Uttar Pradesh, Uttrakhand of inter collegiate level were selected. The age of the subject ranges between 18-25years age. Out of selected twenty subject, ten subjects (N_1=10) were from high performance group and , ten subjects (N_2=10) were from low performance group.

Selection of Variables

Bio-motor and physiological variables was chosen as independent variables for the study, with selected high and low performance group as the dependent variable.

Administration of Test

A. Bio-Motor Variable

1. Grip Strength

- **Purpose-** The objective of this test to measure forearm strength.
- **Equipments-** Hand grip dynamometer, pen, pencil and pad.
- **Procedure -** Both the right and left hands was evaluated on a grip dynamometer to determine grip strength. With the dial towards the form, position the manometer's concave edge between the first and second finger joints. The individual is free to roam about while clutching his instrument as long as he avoids hitting anything with his fist. The upper cut is the most often used motion.
- **Scoring-** The right grip is tested first and then the left scores should be read to the nearest pound. The indicator should be returned to zero after each test. The total average of right and left hand was taken as a score.

2. Back Strength

- **Purpose-** Back dynamometer was used for measuring the isometric strength of back muscles.
- **Equipment-** Back strength dynamometer
- **Procedure-** The subjects were instructed to stand with their trunks slightly bent (10 to 15 degrees) forward at the hips while gripping the dynamometer bar in both of their upper and lower hands. This was accomplished by setting the bar such that it was just over the subject's finger tips while they were standing straight with their hands on their front thighs. The distance between the hands and the shoulders is the same. The feet, which are spaced approximately six inches apart, supported the body weight evenly. The lift travels slowly upward without jerking while the knees and back are held straight the whole time. Three trials were given for this test, and the patient was instructed not to lean backward on their heels. Scoring- The highest of the three readings was recorded in pound) or kilograms.
- **Scoring-**The best result for each hand was recorded nearest to 0.1 kg/lbs.

3. Leg Explosive Power

- **Purpose** The vertical jump test measures a person's capacity to use their maximal amount of energy in one explosive motion to propel their body across space.
- **Equipments** The Sargent Jump Board, Chalk, Tape and Rope.
- **Procedure** Subjects are instructed to place their heels firmly on the ground close to the pillar of concrete and grasp a piece of chalk in their dominant hand. The sargent board was fastened to the base of the 2-meter-tall concrete pillar. The subject is expected to mark the board from this position, reaching as high as possible. Squatting down close to the board, the subject was instructed to do the

leap and then stand up as high as possible to leave a mark. The subject was not permitted to stroll or step into the starting position for the leap.

- **Scoring** The height of the leap was calculated by subtracting the participant's standing height from their final height after jumping. We'll round up to the closest centimeter for all of our measurements. There were three chances, and the best two will count toward the final tally. (Margaret J. Safrit, Terry M. Wood, 1995).

B. Physiological Variables

4. Resting Pulse rate

- **Purpose:** To Measure Resting pulse rate, the procedure prescribed by clayne was followed
- **Equipment:** Stop watch (1/100), Stethoscope.
- **Procedure:** Each participant's heart rate was taken while seated first thing in the morning. Before taking a subject's pulse, we will have them sit quietly for fifteen minutes. Three finger tips were put on the radial artery on the side of the wrist in a way that palpitation was obvious, and the number of palpitations was recorded over the course of sixty seconds to determine the heart rate.
- **Scoring-** Beats in one minute was recorded.

5. Vital capacity

- **Purpose:** To measure the efficiency of lungs
- **Equipment:** Dry Spirometer
- **Procedure:** A dry spirometer was used to determine lung capacity in liters. After inhaling to the utmost extent possible, the individual was instructed to exhale slowly and steadily through the mouthpiece, with the instrument initially set to the "0" position. No air was allowed to escape via the nose or around the rims of the mouthpiece, and the individual was instructed not to take a second breath at any point throughout the experiment.
- **Scoring-** three trails Was allowed for this test and reading was taken on the dial to 1/10 of the liter

6. Body Composition:

- **Purpose-** It describes the percentages of fat in human body.
- **Equipment's-**Skin fold calliper
- **Administration-** This skin fold test was performed on the triceps and calf muscles. The triceps skin fold was measured over the right arm's triceps muscle, midway between the elbow's olecranon process and the shoulder's acromial process and parallel to the upper arm's longitudinal axis. All measurements were taken from the right portion of the body (right arm). The calf skin fold is measured along the inside of the largest part of the calf.
- **Calculations-** The fat percentage was calculated using Slaughter and Lohman children skin fold formula.
- **Body fat percentage-** (0.735 X sum of skin fold) + 1.0 (where, sum of skin fold is triceps skin fold measurement plus calf skin fold measurement)

- **Scoring-** The scores in one trial after measurement of the student's two sites (triceps and calf) for the checking of fat percentage was indicated by skin fold calliper in nearest millimetres and recorded as student's score.

STATISTICAL ANALYSIS

Descriptive statistics such as mean and standard deviation along with independent sample-test was employed in IBM SPSS 20.0 to determine the significant comparative difference among the selected high and low performance group. Along with Leven's test, analysis was done, to determine homogeneity among selected groups.(Verma J P, 2013)j

RESULTS

Variable	Performance	Mean	Std. Deviation
Grip Strength	High Performance Group	44.2650	3.62813
	Low Performance Group	28.3350	5.91430
Explosive Strength	High Performance Group	65.9000	3.31495
	Low Performance Group	61.1000	5.06513
Back Strength	High Performance Group	169.9000	9.93814
	Low Performance Group	156.5000	9.75534
Body Composition	High Performance Group	14.3000	2.57337
	Low Performance Group	15.1000	1.50555
Vital Capacity	High Performance Group	5.9400	0.29967
	Low Performance Group	5.8290	0.36177
Resting HR	High Performance Group	52.1000	2.88483
	Low Performance Group	55.2000	4.82586

Table No 1 Descriptive statistics for Bio-motor and physiological variables

Table No. 1 and Fig No. 1 represents the descriptive statistics i.e., mean and standard deviation for selected bio-motor and physiological variables. For bio-motor variable i.e., Grip Strength high and low performance group mean and standard deviation was 44.26±3.62 kg and 28.33±5.91 kg respectively. For bio-motor variable i.e., Explosive Strength high and low performance group mean and standard deviation was 65.9±3.31 cm and 61.1±5.06 cm respectively. For bio-motor variable i.e., Back Strength high and low performance group mean and standard deviation was 169.9±9.93 kg and 156±975 kg respectively. For physiological variable i.e., body composition high and low performance group mean and standard deviation was 14.3±2.57 and 15.1±1.50 respectively. For physiological variable i.e., vital capacity high and low performance group mean and standard deviation was 5.94±0.29 litres and 5.82±0.361 litres respectively. For physiological variable i.e., resting heart rate high and low performance group mean and standard deviation was 52.1±2.88 bpm and 55.2 bpm ±4.82 bpm respectively.

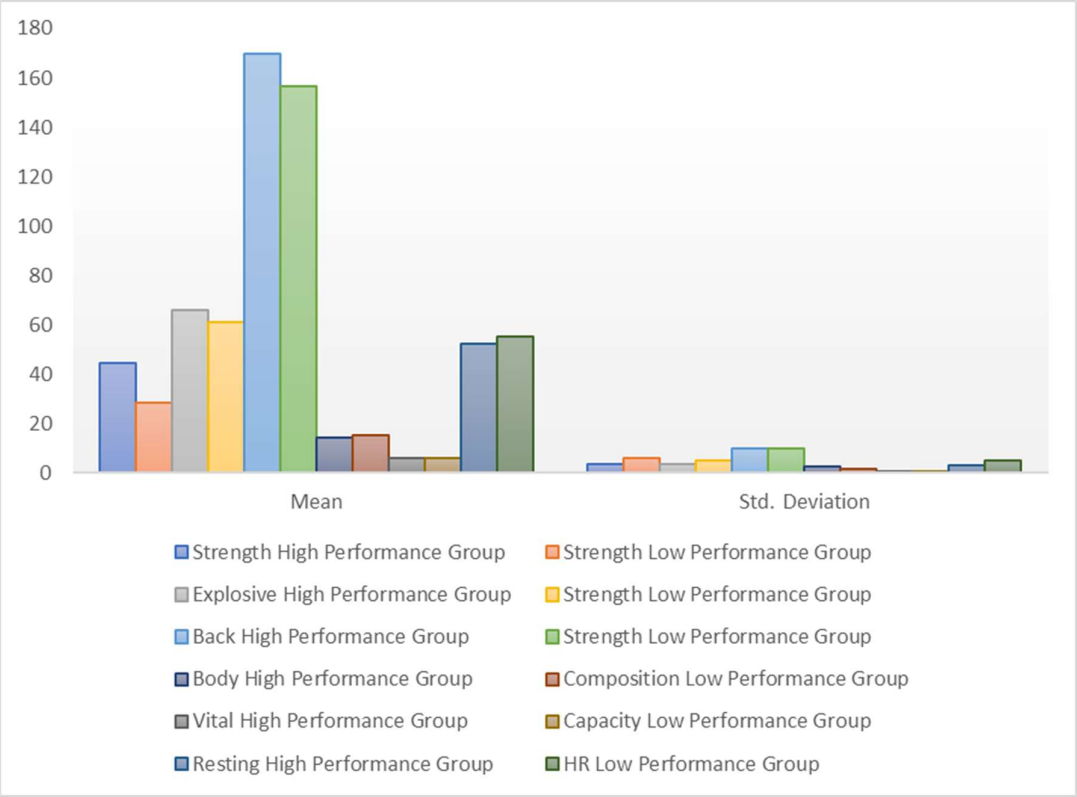

Fig. No. 1 Graphical representation for Bio-motor and physiological variables

Variable		**Levene's Test for Equality of Variances**		**t-test for Equality of Means**			
		F	**Sig.**	**t**	**df**	**Sig. (2-tailed)**	**Mean Difference**
Grip Strength	Equal variance assumed	3.141	.093	7.260	18	.000	15.93
	Equal variance assumed			7.260	14.934	.000	15.93
Explosive Strength	Equal variance assumed	1.468	.241	2.507	18	.022	4.8
	Equal variance assumed			2.507	15.515	.024	4.8
Back Strength	Equal variance assumed	.011	.918	3.043	18	.007	13.4
	Equal variance assumed			3.043	17.994	.007	13.4
Body Composition	Equal variance assumed	5.011	.038	-.849	18	.407	-.80

	Equal variance assumed			-.849	14.515	.410	-.80
Vital Capacity	Equal variance assumed	.278	.605	.747	18	.465	.11
	Equal variance assumed			.747	17.397	.465	.11
Resting HR	Equal variance assumed	3.594	.074	-1.744	18	.098	-3.1
	Equal variance assumed			-1.744	14.704	.102	-3.1

Table No 2- Significance of variation between Mean of Bio-motor and physiological variables for high and low performance group

Table No 2 represents the value of Levens test and T-statistics. The Levens is an assumption for two-sample F-test for determining homogeneity of group.

The obtained value for Levens test for Bio-motor variable i.e., Grip strength, Explosive Strength and Back Strength for high and low performance group was 0.093, 0.241 and 0.918 respectively, which is more than 0.05 and hence the assumption of equality of variance is not violated. The obtained T-value for Bio-motor variable i.e., Grip strength, Explosive Strength and Back Strength for high and low performance group was 7.26, 2.50 and 3.043 respectively which are significant as its p-values are 0.00, 0.02 and 0.007 which are less than 0.05. Thus, the null hypothesis of equality of population means of two groups is rejected and it may be concluded that the Bio-motor variable i.e., Grip strength, Explosive Strength and Back Strength for high and low performance group does differ.

The obtained value for Levens test for Physiological variable i.e., Body Composition, Vital Capacity and Resting Heart Rate for high and low performance group was 0.38, 0.605 and 0.74 respectively, which is more than 0.05 and hence the assumption of equality of variance is not violated. The obtained T-value for Physiological variable i.e., Body Composition, Vital Capacity and Resting Heart Rate for high and low performance group was -0.849, 0.747 and -1.744 respectively which are significant as its p-values are 0.407, 0.465 and 0.098 which are more than 0.05.

Thus, “the null hypothesis of equality of population means of two groups is accepted and it may be concluded that” the Physiological variable i.e., Body Composition, Vital Capacity and Resting Heart Rate for high and low performance group doesn’t differ.

DISCUSSION ON FINDINGS

The result of the pertaining study identified hand grip strength, back strength and explosive strength as discriminating variables whereas, body composition, vital capacity and resting heart rate are not having significant difference among themselves for 66 kg weight category judokas. Hand grip strength along with back and explosive strength allows better execution of technique and impairing opponent. (Nandal & Kumar, 2024) Hand grip strength is also important because in judo a lot of actions are done through elbow, shoulder, back where

continuous flexion extension around those anatomical area has to be performed where a strong grip is required for execution.(Kons RL et. al., 2018) In order to gain upper hand in judo throws plays important role for example “ippon seoi nage” and “morote seoi nage” are two major one arm and two arm hip throws technique which allow the judoka to win a particular game hence back and explosive strength plays important role here.

There was no sig. diff. obtained body composition, vital capacity and resting heart rate for this study might be because of two reason firstly, sample size and secondly high performance group athlete were state and nation champions but none of them was having international training exposure or elite level state of training, hence selected physiological variable doesn’t seems to be discriminating.

CONCLUSION

In conclusion, the most discriminating variables from selected bio-motor (hand grip strength, back strength and explosive strength) and physiological variables (body composition, vital capacity and resting heart rate). For this purpose, twenty male (N=20) judokas of 66 kg weight category from Delhi, Madhya Pradesh, Uttar Pradesh, Uttarakhand of inter collegiate level were selected. The age of the subject ranges between 18-25years age. Out of selected twenty subject, ten subjects (N_1=10) were from high performance group and, ten subjects (N_2=10) were from low performance group. Independent sample-test was employed in IBM SPSS 20.0 to determine the significant comparative difference among the selected high and low performance group. According to results of the study selected bio-motor variables were found to be significant discriminating when compared to physiological variables.

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