



## Effect of Interval Training upon Muscular Endurance of University Students

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### **Abstract**

The healthy life is based upon the health related physical fitness. A quality life and routines is achieved by means of physical fitness, which is the need of all the people of all ages, sex and professions. Muscular endurance is key component of physical fitness. The study in hand aimed to investigate the effects of interval training upon the muscular endurance of the university students. The population of the study was the university's students living in hostels of Government College University, Lahore, Pakistan. A sample of thirty students (n=30) was chosen. The Physical Activity Readiness Questionnaire (PAR-Q) was used to collect the data. The sample was divided into two groups. One was the experimental and the other was the control group. The pre test data was on muscular endurance was collected through one minute push-ups. The experimental group was given three days consecutive interval training for eight (8) weeks. The control group was left at their general routines. After training the post data was calculated and the push-ups test was again taken. The data was analyzed through descriptive statistics (mean, standard deviation, minimum and maximum) and inferential statistics (independent sample t-test and paired sample t-test) with a significance level of 0.05. The analyzed data prevailed that the interval training has significantly improved the muscular endurance of the participants, while the no improvements had seen in the control group.

**Key words:** Interval Training, muscular Endurance, physical fitness. exercise and University students

### **Introduction:**

The muscular endurance is the ability of the muscles the work effectively and efficiently without any tiredness for longer period of time. The muscular endurance is the essential part of the physical



fitness. Students face numerous challenges in their lives related to their academics and routines. It needs the continuous ability and the endurance in their muscles plus body parts. The exercises have the potential to make them healthy, retrieve the fatigue, exhaustion and depression level (Powers & Howley, 2017). Interval training is framed by alternate periods of high intensity exercise with low intensity recovery. The interval training has been recognized as useful way for enhancing the various aspects of physical fitness that also includes the muscular endurance. This introduction explores the impact of interval training on muscular endurance among university students, backed by extensive research and theoretical frameworks.

The physical activities play pivotal role in the boosting the mental health of the students. Students are supposed to need energy for their daily tasks. Participation in sports and physical activities help the students to improve their endurance level that leads to the overall fitness also. Physical activities are the better source of relieving the stress and fatigued during any work (Smith et al., 2019). The muscular endurance is important for students that require sustained effort, such as long-distance running, swimming, rowing, and team sports. The enhanced muscular endurance allows the students to perform at higher levels for longer period of time. It reduces the risk of fatigue, injuries and improves the overall performance (Powers & Howley, 2017).

University students remain a unique population with distinct physical and psychological needs. They often balance academics, part time jobs, social activities and have their personal interests. They often have irregular schedules and face high levels of stress (American University of Sports Medicine, 2017). The study of Schoenfeld (2010) has found that effects of interval training on muscular endurance has various processes that includes randomized controlled trials, cross over designs, and longitudinal studies. The general measure of muscular endurance has repetitions to failure, time to exhaustion tests and specific endurance tasks such as plank holds or push-up tests.

The interval training is achieved in specific time and often done with efficiency and effectiveness. Although it is a short duration activity but produces comparable or superior fitness improvements as compared to traditional moderate intensity continuous training (MICT) (Weston et al., 2014). One of the main advantages of interval training is to enhance the muscular endurance, which can attribute to many physiological and psychological mechanisms. Interval training induces both aerobic and anaerobic adaptations, improves the efficiency of energy systems involved in prolonged muscular activity. Key adaptations include increased mitochondrial density, enhanced oxidative enzyme activity, improved capillary density, and greater glycogen storage capacity in muscles (Holloszy, 1967; Laursen & Jenkins, 2002).

The adaptations used in interval training enhance the muscles' ability to keep the repeated contractions. This increases oxygen delivery, utilization, increasing energy production and reduces the accumulation of fatigue inducing metabolites. The interval training has shown improvements in neuromuscular coordination and muscle fiber recruitment patterns. Furthermore, it contributes to enhanced muscular endurance also (Buchheit & Laursen, 2013).

A study of Astorino et al. (2012) has suggested that the impacts of interval training on muscular endurance have yielded significant results upon various populations that also includes the university students. Interval training has significant improvements in muscular endurance and cardiovascular fitness following a six-week HIIT program in sedentary young adults. Participants in the study experienced increased performance in endurance tests, highlighting the efficacy of interval training in enhancing muscular endurance.

The interval training remains effective in reducing the risk of cardio-metabolic disease and improves the overall fitness in a efficient way. The study concluded that the potential of HIIT to provide significant health benefits with shorter workouts and durations. This is most suitable option for university students with limited time (Kessler, Sisson & Short, 2012).

Interval training has the alternate periods of high intensity exercise and low intensity recovery



or rest periods. It can be adopted for achieving various fitness levels and goals. It is suitable for all individuals with no difference of age, sex and working capacities. It could be given to the university students. The high intensity interval training (HIIT) and sprint interval training (SIT) are kinds of interval training. The both have shown significant improvements in fitness parameters, including cardiovascular fitness, muscular Endurance, and endurance (Gibala et al., 2012).

A meta-analysis study of Vollaard, Metcalfe, and Williams (2017) also stated the effectiveness of interval training in enhancing muscular endurance. The analysis included studies across different populations and found consistent improvements in muscular endurance following interval training interventions. The authors highlighted the adaptability of interval training protocols allowing them to be tailored to individual fitness levels.

In designing studies to evaluate the impact of interval training on muscular endurance among university students, several factors must be considered. These include the intensity and duration of the intervals, the total duration of the training program, and the specific exercises used. Participant adherence and motivation are also critical factors influencing the outcomes of interval training interventions (Keating et al., 2020).

Understanding the impact of interval training on muscular endurance has practical implications for developing effective fitness programs for university students. Given the time constraints and varying fitness levels among students, interval training offers a flexible and efficient approach to improving muscular endurance. Fitness programs incorporating interval training can be designed to fit into students' schedules while providing significant health and fitness benefits.

Additionally, promoting interval training among university students could foster long-term exercise adherence by offering variety and reducing the monotony often associated with traditional endurance training. Educating students on the benefits and proper execution of interval training can empower them to take charge of their fitness and well-being (Ryan et al., 2016).

While existing research supports the effectiveness of interval training in enhancing muscular endurance, further studies are needed to explore optimal training protocols and long-term effects, particularly among university students. Future research should investigate the impact of different interval training modalities, such as HIIT and SIT, on muscular endurance and other fitness parameters. Additionally, studies should examine the effects of interval training on diverse student populations, considering factors such as gender, age, and baseline fitness levels.

Exploring the psychological and behavioral aspects of interval training, including motivation, adherence, and enjoyment, could also provide valuable insights for developing more engaging and effective fitness programs for university students. By addressing these research gaps, future studies can contribute to a more comprehensive understanding of the benefits and best practices for interval training in enhancing muscular endurance.

### **Objectives of the study**

- To quantify the effects of interval training upon muscular endurance of the University students
- To suggest recommendations to the university students for enhancement of muscular endurance.

### **Delimitations of the study**

- 1) Thirty students of GCU, Lahore, boarded, were taken as subjects.
- 2) The age range of the population was 18-25 years.
- 3) The study was delimited to male only.
- 4) Population was in two groups, experimental group and control Group.
- 5) Eight weeks interval training with three sessions per week on alternate days (Monday, Wednesday and Friday) was given to the population.

### **Materials and methods**

It was the experimental research. The participants of the study are the aggregate of all the subjects, objects or members that are directly related to the under taken problem in connection with collection of



the necessary data (Keating et al., 2020). Government College University of district Lahore was chosen for the study. Punjab is located in the North of Punjab (province) of Pakistan. The participants of the study were comprised all the students (18-25 years) who were residing in the hostel of GCU, Lahore and the total number of the students in hostel was Four hundred.

#### **Exclusion/inclusion criteria**

To select appropriate subjects for the study, the Physical Activity Readiness Questionnaire (PAR-Q) was used as both the exclusion and inclusion criteria. The PAR-Q is a screening tool consisting of closed-ended questions, typically used by fitness trainers to identify suitable participants and minimize health risks (Warburton, Jamnik, Bredin, & Gledhill, 2011).

For this study, the following criteria were applied:

#### **Inclusion Criteria:**

- Students aged 18 to 25 years
- Boarding students residing in the hostel

#### **Exclusion Criteria:**

- Students with heart disease, chest problems, episodes of unconsciousness, musculoskeletal disorders, hypertension, or joint issues
- Students who have participated in aerobic or anaerobic activities in the past six months
- Students with a history of smoking

These criteria ensured the selection of fit and healthy participants for the study, focusing on the effects of interval training on muscular endurance among university students.

#### **Selection of subjects**

After the distribution and collection of PAR-Q among four hundred students, two hundred and fifteen students were fit for participation in the study. Among the two hundred and fifteen students, a sample of thirty students ( $n=30$ ) was selected randomly as subjects for the in-hand study. Further the selected subjects were equally and randomly divided into two groups each one of fifteen subjects which were Experimental Group A (Interval Training) and Control Group B (No treatment).

#### **Instrument for collection of data:**

Instrument is a measurement device. In research study, instrument is a tool that researcher uses for the collection of data (Kola, 2017). There are various instruments like questionnaire, interview, test etc., and the selection of instrument depends upon the nature of study (Harris & Brown, 2010). The current study was undertaken to determine the effects of Interval Training upon muscular Endurance among University students. According to the available literature, push-ups/minute test was selected for the collection of data on muscular Endurance. The pus-ups performed in one-minute were recorded in number. Muscular Endurance was measured through push-ups performed in one minute. Mat and stop watch was used as equipment's.

#### **Procedure**

After warm up, each subject was asked to take prone lying position on the mat with hands under the shoulders and fingers stretched. His legs were straight and parallel apart and the toes under the feet. After taking the stated position, with the command 'go', the subject performed push-ups with the arms extended completely. The back and legs were kept straight throughout the test. Then the subject lowered his body using the arms till they reach to 90-degree angle and upper arms parallel to the ground. One push-up was counted subject completed a cycle of up-down-up. The action was repeated as many times as possible in one minute.

#### **Scoring**

The total correctly executed push-ups per minute were recorded.

#### **Pilot study:**

Keeping in view the limitations of the subjects for satisfaction, a pilot study was carried out to evaluate the initial capability of the subjects and ensure the suitability, frequencies and duration of training program (Interval training). For this purpose, ten subjects were selected at random and went through Interval Training. The average performance of ten subjects was calculated. The protocol of Interval training of 08 weeks was designed for respective group on the basis of the response of the subjects in the pilot study. The basic principles of training were also followed by the researcher while designing the training protocols.

### Protocol of Interval training:

A self-administered Interval Training protocol of 08 weeks was developed for the subjects of experimental group A. The intensity of exercise was 50% to 60% of Maximum Heart Rate (220-age) for the first four weeks while 60% to 70% of MHR for the last four weeks. Training session was started and concluded with warm up (light dynamic stretching exercises and walk) and warm down (Walk, light stretching exercises with deep breath) respectively each of 10 minutes.

Prior to the start of training, each exercise was explained and demonstrated to the subjects so that all the exercises may be executed correctly. After the warm up session, the subjects performed Interval Training exercises (Jumping jack, Sit ups with straight legs, Heel raising, abdominal crunch, Knee highs, push-ups, Legs raising, Burpees/plank, Light jumping and Lunges) on the basis of interval method i.e. there was pause between exercises. All the exercises were performed vertically. There was no restriction on the subjects for the repetitions of exercises but the subjects had to do it continuously till the end of stipulated time within heart rate zone. On whistle, the subjects started exercise allotted to the particular station. At the end of stipulated time for exercise, the whistle was blown and the subjects had to proceed to next station in the clock wise direction. There was also rest interval between sets.

### Statistical analyses

#### Section A: Descriptive analyses

**Tale 1. Demographic/ Anthropometric measurement of age, height and weight of the subjects of Experimental group and Control group.**

Group	N	Measure	Minimum	Maximum	Mean	Std. Deviation
Experimental Group	15	Age (years)	18.00	25.00	20.20	2.10
		Height (cm)	165.00	185.00	174.50	7.20
		Weight (kg)	58.00	82.00	70.10	9.00
Control Group	15	Age (years)	18.00	25.00	21.00	2.20
		Height (cm)	162.00	180.00	170.30	5.50
		Weight (kg)	60.00	79.00	68.00	6.00

#### Section A: Inferential analyses

##### Pre-treatment matching process

**Table 2. Pre-treatment comparison among age, weight and height measurements of Experimental group and Control group Variables**

	Groups	N	Mean	St. Dev	Std. Error	Df	t	Sig.
Age (years)	Experimental Group	15	20.20	2.10	0.54	28	-1.432	0.162
	Control Group	15	21.00	2.20	0.57			
Height (cm)	Experimental Group	15	174.50	7.20	1.86	28	2.034	0.041
	Control Group	15	170.30	5.50	1.42			
Weight	Experimental	15	70.10	9.00	2.32	28	0.652	0.420

(kg)	Group							
	Control Group	15	68.00	6.00	1.55			

The table shows that there is no significant difference (0.05) among age, height and weight between the Experimental group and Control group before the treatment.

**Table 3. Pre-treatment difference between muscular Endurance of Experimental group and Control group**

Variable	Groups	N	Mean	Std. Dev	Std. Error Mean	Df	t	Sig.
Muscular Endurance (pre-test)	Experimental Group	15	15.40	4.85	1.25	28	0.452	0.425
	Control Group	15	14.80	5.20	1.34			

The table indicates that there is no significant difference ( $0.425 < \alpha = 0.05$ ) in muscular Endurance between experimental group ( $M=15.40 \pm 4.85$ ) and control group ( $M=14.80 \pm 5.20$ ) before the treatment (Interval training).

**Pre-test and post-test Comparisons of muscular Endurance of each group**

**Table 4. Pre-test and Post-test comparison of muscular Endurance of Experimental group and Control group**

Variable	Groups	N	Mean	Std. Dev	Mean diff	Df	Sig.
Experimental Group	Muscular Endurance (pre-test)	15	14.50	4.95	-7.20		.000
	Muscular Endurance (post-test)		21.70	5.10			
Control Group	Muscular Endurance (pre-test)	15	13.30	5.80	-1.00		.035
	Muscular Endurance (post-test)		14.30	5.50			

The table shows that there is significant difference ( $.000 < \alpha = 0.05$ ) in muscular Endurance between the pre-test and post-test of experimental group (14.50 cm < 21.70 cm, Improvement = -7.20cm) however there is no significant difference ( $.035 > \alpha = 0.05$ ) in flexibility between the pre-test and post-test of control group (13.30 < cm 14.30 cm, Improvement = -1.00 cm).

**Post-test comparison between the Experimental group and Control group**

**Table 5. Post-test comparison of muscular Endurance between Experimental group and Control group Variable**

Variable	Groups	N	Mean	Std. Dev	Std. Error Mean	Df	t	Sig.
Muscular Endurance (post-test)	Experimental Group	15	21.70	5.10	1.32	28	4.333	0.000
	Control Group	15	14.30	5.50	1.42			



The table shows that there is significant difference ( $.000 < \alpha = 0.05$ ) between the post-test muscular Endurance of experimental group and control group i.e. the treatment of interval training has significant effects on muscular Endurance

The results of the current study showed significant improvement positively of Interval Training i.e. ( $p < 0.05$ ) on muscular Endurance.

The study of Rengasamy (2012) contradicts the result of current study with reference to the muscular Endurance. The main reason behind the contradiction between the findings of both studies with regard to the muscular Endurance is their measurement method and protocol. In the current study, the muscular Endurance was measured with the test of push-ups performed/minute and there were also push-ups exercise in the protocol which significantly enhanced the muscular Endurance. In the study of Rengasamy (2012) the muscular Endurance was measured with hand dynamometer which only measures hand Endurance and perhaps no exercise was included in for the use of hands muscles.

Similarly, a study was also conducted by Kim, Ko, Seo & Kim (2018) to find out the effects of Interval Training on muscular Endurance. Though obese female students were selected as subjects for the study yet the Interval Training enhanced their muscular Endurance. Thus, the findings of the current study endorse the findings of the mentioned study in perspective of the development of muscular Endurance which is one of the key components of health-related physical fitness.

#### **Finding of the study**

The hypothesis of the study was about the effects of interval training upon muscular endurance among University students (18-25). The past researches have shown that interval training has positive effects upon the muscular strength of the human beings. As the data of this study was analyzed the results shown significant relationship of interval training with muscular endurance of the participants having age 18-25 years. The findings showed that after having 8 (eight) weeks training positive relationship has been observed. Therefore the study hypothesis H1 has been accepted.

#### **Conclusion of the study**

The study finalized the conclusion as the data of was analyzed. One of the objective of the study was to identify the effects of interval training upon muscular endurance of the students of the university having age 18-25 years. The study after having the interval training and data analyses that there is a positive effect of interval training upon the muscular strength of the students as compared with control group.

#### **Recommendations**

Keeping in view the finding and conclusion, the following recommendations are made:

1. The research study find out that interval training has significant relationship with the development of muscular strength of the students. keeping in view this logic it is recommended for the Government that while designing the curriculum of the students in general and specifically of sports sciences,. The curriculum should have interval training programs to develop the muscular strength and other potentials as well.
2. As this training can be performed without special needs. So any types of organization could adopt this training as exercise for boosting the working capacity of the employees.
3. Exercise keeps a person healthy and fit, while fitness is key to success. Therefore an individual can grow the capabilities of his/ herself should opt this, interval training in his/ her routines.

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