



ISSN: 2456-0057  
IJPNPE 2018; 3(1): 1613-1616  
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[www.journalofsports.com](http://www.journalofsports.com)  
Received: 27-11-2017  
Accepted: 28-12-2017

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## Effect of strength and endurance training on physiological variables among high school students

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### Abstract

The purpose of the study was to find out the Effect of Strength and Endurance Training on Physiological Variables among High School Students. To achieve for this purpose 40 Students ranging 13-17 years of age. The subjects were divided into three equal groups. The following Physiological Variables are Pulse Rate and Vital Capacity were selected and the Pre-test and Post-test design applying of co-variance technique was adopted for interpreting the results.

**Keywords:** Strength training, endurance training, and physiological variables

### Introduction



Strength Training is a type of Physical Exercise specializing in the use of resistance to induce muscular contraction which builds the strength, anaerobic endurance, and size of skeletal muscles. Strength training may be important to metabolic and cardiovascular health. Recent evidence suggests that resistance training may reduce metabolic and cardiovascular disease risk. Over weight individuals with high strength fitness exhibit metabolic/cardiovascular risk profiles similar to normal-weight, fit individuals rather than overweight unfit individuals. Strength Training is a type of Physical Exercise specializing in the use of resistance to induce muscular contraction which builds the strength, anaerobic endurance, and size of skeletal muscles.

Endurance Training is the act of exercising to increase endurance. The term endurance training generally refers to training the aerobic system as opposed to the anaerobic system. The need for endurance in sports is often predicated as the need of cardiovascular and simple muscular endurance, but the issue of endurance is far more complex. Endurance can be divided into two categories including: general endurance and specific endurance. It can be shown that endurance in sport is closely tied to the execution of skill and technique. A well conditioned athlete can be defined as, the athlete who executes his or her technique consistently and effectively with the least effort.

Physical Training is to bring oneself to the required pitch of physical condition to acquire skill and precision in movement, by steady practice for general fitness, for a specific contest or forms of sports.

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Training builds efficiency, in body adoptability which enhances body's adjustments while performing an activity requiring maximum or near maximal performance over a considerable period of time. A sound training Endurance causes functional biochemical and morphological changes in the body resulting in adaptation in training load. Strength Training is to subject the body to repeat but short intermittent periods of reduced intensity. The intensity of the training as the length of the recovery period can be ascertained by



checking the runner's pulse when his pulse has returned to 60 percent and 70 percent of normal, he is ready to begin in his next interval. The purpose of Endurance is to purify the nerves and thereby to strengthen the nervous system. It is as easy to do as it is useful. Increase its duration gradually after attaining the concentration of mind.

### Pulse Rate and Vital Capacity



The number of pulse beats per minute, normally the same as the heart rate. The normal pulse rate in an average adult varies from 60 to 80 beats/min, with fluctuations occurring with exercise, injury, illness, and emotional reactions. The average pulse rate for a newborn is 120 beats/min, which slows

throughout childhood and adolescence. At about 12 years of age, females begin to have a higher pulse rate than males.

### Vital Capacity



Vital capacity (VC) is the maximum amount of air a person can expel from the lungs after a maximum inhalation. It is equal to the sum of inspiratory reserve volume, tidal volume, and expiratory reserve volume.

A person's vital capacity can be measured by a wet or regular spirometer. In combination with other physiological measurements, the vital capacity can help make a diagnosis of underlying lung disease. Furthermore, the vital capacity is used to determine the severity of respiratory muscle involvement in neuromuscular disease, and can guide treatment decisions in Guillain–Barré syndrome and myasthenia crisis. A normal adult has a vital capacity between 3 and 5 liters. A human's vital capacity depends on age, sex, height, mass, and ethnicity. Lung volumes and lung capacities refer to the volume of air associated with different phases of the respiratory cycle. Lung volumes are directly measured, whereas lung capacities are inferred from volumes.

### Statement of the Problem

The study under investigation involves the experimentation of Effect of Strength and Endurance Training on Pulse Rate and Vital Capacity among High School Students.

### Hypotheses

It was hypothesized that there would be Significant Effect due to Strength and Endurance Training on Pulse Rate and Vital Capacity.

### Methodology

In this methodology the selection of subjects, variables, selection of tests, reliability of tests and data, orientation to the subjects, collection of data, tests administration experimental design and statistical process has been explained.

### Statistical Analysis

The data collected from Endurance Group, Strength Training Group and Control Group or Pulse Rate and Vital Capacity before and after training were analyzed through analysis of co-variance.

### Results of the Study

#### Pulse Rate

The analysis of covariance on Pulse Rate consumption of the Pre and Post-test scores of Endurance Group, Strength Training Group and Control Groups have been analyzed and

presented in Table-1.

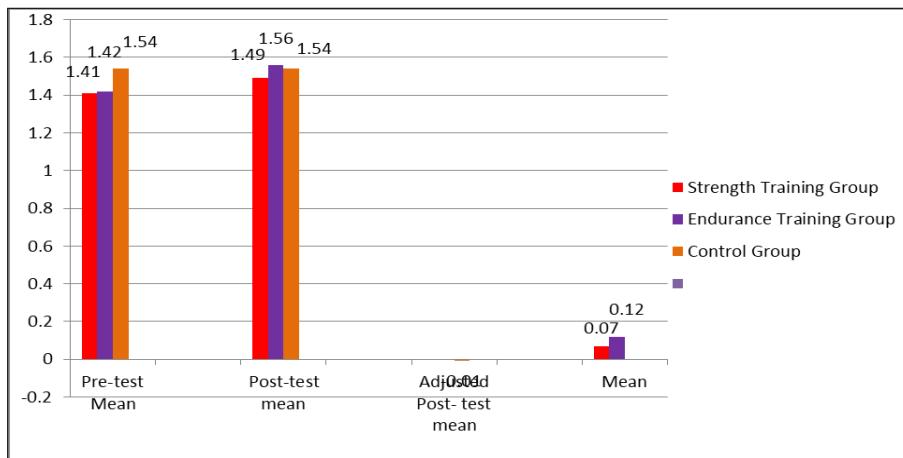
Analysis of co-variance of data on Pulse Rate between Pre

and Post-test means of Endurance Group, Strength Training Group and Control Group (in liters per minute).

**Table 1**

Test	Strength Training Group	Endurance Training Group	Control Group	Source of Variance	Sum score	DF	Max. sq. value	'F' ratio
Pre-test Mean	1.41	1.42	1.54	Between	0.177	2	0.07	
				Within	11.648	85	0.13	0.6 <sup>NS</sup>
Post-test mean	1.49	1.56	1.54	Between	0.073	2	0.035	
				Within	9.500	85	0.108	0.34 <sup>NS</sup>
Adjusted Post- test mean			-0.01	Between	0.129	2	0.068	
				Within	0.329	84	0.002	16.4 <sup>**</sup>
Mean	0.07	0.12						

NS -- Not Significant<sup>\*\*</sup> -- Significant at 0.1 level

**Table 1A:** Ordered adjusted Pulse Rate Means, Differences Between means among Endurance, Strength Training and Control Groups.

Endurance Group (N = 10)	Strength Group(N=10)	Control group(N=10)	Mean difference
1.53	1.59		0.05 **
	1.59	1.46	0.12 **
1.53		1.46	0.06 **

HSD need for Significance, \*\* Significant at 0.1 level  
0.039 at - 0.5 level, 0.049 at - 0.1 level

Table 1: Shows the analyzed data in Pulse Rate. The Pre-test means were 1.42 liters for Strength Training Group 1.41 liters for Endurance Group and 1.54 liters for Control Group. The result of 'F' ratio of 0.6 which indicated that the three groups were not significant in Pulse Rate at the beginning of the Training. The difference between Post-test means 1.56 liters 1.49 liters and 1.54 liters for the same groups respectively yielded and 'F' ratio of 0.34 was not significant at both levels. The difference between the adjusted Post-test means of 1.59, 1.53 and 1.46 liters per minutes for the groups respectively showed an "F" ratio of 16.4 which highly significant at 0.1 level, for the degree of freedom 2 and 84. Hence null hypothesis was rejected.

As given table-2 with regard to the differences between paired adjusted final means, the difference of 0.05 between

Endurance, Strength Training Group, the difference of 0.12 between Strength Training and Control Groups, and the difference of 0.06 between Endurance and Control Groups were Significant at .01 level as the difference were greater than the resultant confidence Strength of 0.049 at .01 level as resulted through HSD method.

The result indicates that the Strength and Endurance Training Groups had significantly increased in Pulse Rate Strength of means gains.

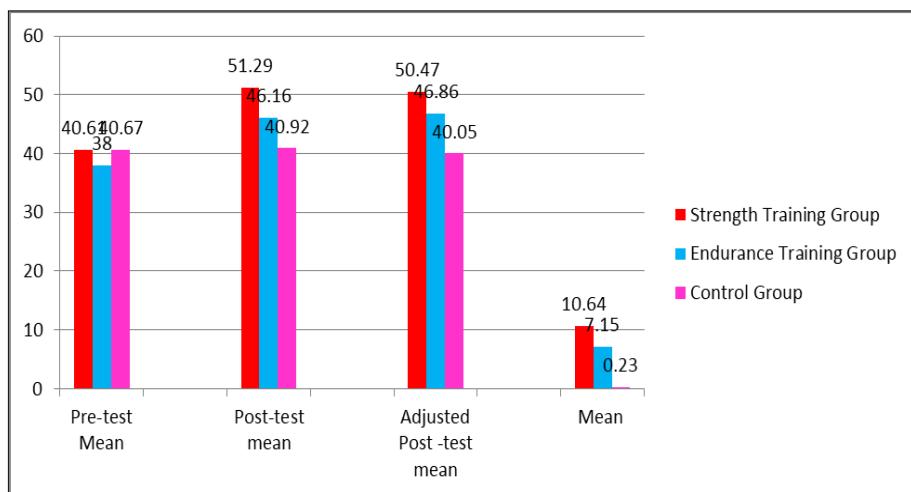
### Vital Capacity

Computation of analysis of Co-variance of Pre-test and Post-test Vital Capacity of Strength Training, Endurance and Control Groups (in seconds).

**Table 2**

Test	Strength Training Group	Endurance Training Group	Control Group	Source of Variance	Sum scenes	Df	Mean scores	'F' ratio
Pre-test Mean	40.61	38.00	40.67	Between	138.87	2	60.42	1.7 NS
				Within	3230.79	86	35.12	
Post-test mean	51.29	46.16	40.92	Between	1611.04	2	803.50	15.61 <sup>**</sup>
				Within	3976.05	86	43.60	
Adjusted Post - test mean	50.47	46.86	40.05	Between	1758.29	2	875.13	71.80 <sup>**</sup>
				Within	324.61	85	11.89	
Mean	10.64	7.15	0.23					

NS – Not significant, \*\* Significant at .01 level



**Table 2A:** Ordered Adjusted Vital Capacity means and difference between means among Endurance, Strength Training and Control Groups (in seconds).

Endurance Group (N = 10)	Strength Group (N=10)	Control group (N=10)	Mean difference
50.46	46.85		2.59**
	46.85	40.04	5.79**
50.46		40.04	09.38**

HSD need for significance, \*\* Significant at .01 level  
2.13 at .05 level, 2.68 at .01 level

### Result of the Study

Table-2 reveals that the difference between the Pre-test means of Vital Capacity were 38.00 seconds for Strength Training Group, 40.61 seconds for Endurance Group and 40.67 seconds for Control Group and yielded an F-ratio of 1.7 in significant at both the .05 level and .01 level the difference between the Post-test means of 46.16 seconds, 51.29 seconds and 40.92 seconds for the same groups respectively requested in an F-ratio of 15.61, significant at .05 level. The difference between adjusted means of 46.86 seconds, 50.47 seconds and 40.05 seconds for the same groups respectively were founded highly significant with 'F1' ratio of 71.80 well beyond .01 level for degree of freedom 2 and 85 and the null hypothesis was rejected. As shown in table 2 regarding the differences between paired adjusted final means, the mean differences of 2.59 between Strength Training and Endurance Group, 5.79 between Strength Training and Control Groups. 09.38 between Endurance and Control Groups were significant as these values were greater than the required confidence Strength (HSD) of 2.13 at .05 level and 2.68 at .01 level. The analysis of Vital Capacity data revealed that during experimental period, the Endurance Group had significantly increased the Vital Capacity time when compared with Strength Training and Control Groups.

### Conclusion

There was a significant improvement in the performances of Physiological Variables. However this improvement was in favor of Experimental Group due to eight weeks of step Strength and Endurance Training program. There was a significant difference between experimental and control groups on Strength and Endurance.

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