# INFLUENCE OF HIGH ALTITUDE TRAINING AND LOW ALTITUDE TRAINING ON SELECTED PHYSIOLOGICAL VARIABLES AMONG LONG DISTANCE RUNNERS

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**Abstract**

*The purpose of the study was to find out the influence of high altitude training and low altitude training on selected physiological variables among long distance runners. To achieve the purpose, 30 male college students (long distance runners) were randomly selected as subjects from University of Kashmir and its affiliated colleges, India. Their age mean and height were 20±2.1 years, 169±1.1 cm respectively. They were randomly divided into three equal groups, and each group consisted of ten (n = 10) subjects, in which, Group I underwent high altitude training, Group II underwent low altitude training and Group III acted as control. All the subjects in the experimental groups (I & II) were given their respective training programme was performed three days/wk training for twelve weeks duration. The study was restricted to the following selected dependent variables namely resting heart rate, vital capacity and breath holding time; they were tested by standardized test items such as nostril clip method, stethoscope and spirometer tests . The participants were trained for twelve weeks of three days a week (alternate days). A pre and post test randomized design was employed for this investigation. The collected data were statistically analysed by using dependent-'t' test and ANCOVA. The Scheffe's test was used as post-hoc test to determine which of the paired means differed significantly where the differences in adjusted post-test means resided in univariate ANCOVA among three groups. All the above statistical analysis tests were computed at 0.05 level of significance (P<0.05). It was concluded that, the high altitude training and low altitude training groups had significantly improved the participant's resting heart rate, vital capacity and breath holding time when compared than the control group and also made significant differences among experimental and control groups. The high intensity aerobic group had significantly outperformed than the moderate intensity group on participant's selected performance variables. However, the control group had not shown any significant improvement on selected variables.*

***Keywords**: High Altitude, Low Altitude, Resting Heart Rate, Vital Capacity, Breath Holding Time.*

## Introduction

Altitude training is the practice by some endurance athletes of training for several weeks at high altitude, preferably over 2,400 metres (8,000 ft) above sea level, though more commonly at intermediate altitudes due to the shortage of suitable high-altitude locations. This practice has been used for decades. Different environmental conditions with a reduction in ambient oxygen cause adaptive changes to sportsmen's organisms, which can be described as "natural doping". The process of metabolic adaptation to a changed environment takes place in tissues at the cellular level without the necessity of drug intake **(Strzała, 2011).**

At high altitude hypoxia, cold, and dehydration can lead to breathlessness, headaches, nausea, dizziness, and fatigue, and possibly altitude illness including syndromes such as acute mountain sickness, high altitude pulmonary oedema, and cerebral oedema. Running at high altitudes decreases the amount of oxygen getting to the muscles. A low atmospheric pressure in the thin air makes the blood less oxygen-rich as it travels to the muscles. As the marathon proceeds and runners climb higher, the problem gets worse and worse as the runners' oxygen demands increase. Regardless of whether a runner lives and trains at a high altitude or not, high altitude slows performance **(Ward, 2000).**

The cognizance of advantageous physiological changes in an organism following hypoxia ensures that athletes readily use altitude training. In sport, there is a belief that it is possible to plan an AT period in such a way that the enhanced endurance obtained as a result of adaptation to hypoxia will appear after the athlete has returned from the mountains and can benefit competition **(Vogt, 2001).**

Classical altitude training requires the training process of athletes living and training at low to moderate natural altitude, the so-called "live high, train high." Another approach for athletes is the "live high, train low," which seems effective to mitigate the deleterious effects of altitude exposure caused by decline of training intensity **(Friedmann-Bette, 2008).**

The regulations are generally attributed to hematological, cardiovascular and ventilator mechanisms. However, training at altitude leads to enhanced total hemoglobin mass, erythropoietin volume, red cell volume, muscle buffering capacity, capillary density, maximal aerobic capacity, exercise capacity and exercise economy **(Płoszczyca, 2018).**

## Purpose of the Study

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## Methodology

The purpose of the study was to find out the influence of high altitude training and low altitude training on selected physiological variables among long distance runners. To achieve the purpose, 30 male college students (long distance runners) were randomly selected as subjects from University of Kashmir and its affiliated colleges, India. Their age mean and height were 20±2.1 years, 169±1.1 cm respectively. They were randomly divided into three equal groups, and each group consisted of ten (n = 10) subjects, in which, Group I underwent high altitude training (HATG), Group II underwent low altitude training (LATG) and Group III acted as control (CG). All the subjects in the experimental groups (I & II) were given their respective training programme was performed three days/week for twelve weeks duration. The study was restricted to the following selected dependent variables namely resting heart rate, vital capacity and breath holding time; they were tested by standardized test items such as nostril clip method, stethoscope

and spirometer tests. The participants were trained for twelve weeks of three days a week (alternate days). A pre and post test randomized design was employed for this investigation. The collected data were statistically analysed by using dependent-'t' test and ANCOVA. The Scheffe's test was used as post-hoc test to determine which of the paired means differed significantly where the differences in adjusted post-test means resided in univariate ANCOVA among three groups. All the above statistical analysis tests were computed at 0.05 level of significance (P<0.05).

**Results and Discussion**

**TABLE I**
**MEANS, STANDARD DEVIATION AND DEPENDENT-'T' TEST VALUES ON SELECTED VARIABLES OF EXPERIMENTAL AND CONTROL GROUPS**

| Variable Name | Test | High Altitude Training Group | Low Altitude Training Group | Control Group |
|---|---|---|---|---|
| Breath Holding Time | Pre Test | 36.92 | 37.49 | 37.25 |
| | Post Test | 53.75 | 49.82 | 39.41 |
| | **t- test** | 12.84* | 15.05* | 1.67 |
| Resting Heart Rate | Pre Test | 74.40 | 75.33 | 75.26 |
| | Post Test | 70.12 | 72.46 | 74.98 |
| | **t- test** | 9.23* | 11.32* | 1.04 |
| Vital Capacity | Pre Test | 3.47 | 3.46 | 3.48 |
| | Post Test | 4.22 | 4.03 | 3.52 |
| | **t- test** | 9.46* | 13.74* | 1.64 |

**Significant at. 05 level. The Table Value required at. 05 levels with df 9 is 2.26.*

From the table-I, the high altitude training and low altitude training groups had significantly improved on selected physiological variables while compared than the control group.

**TABLE II**
**ANALYSIS OF COVARIANCE ON SELECTED PERFORMANCE VARIABLES AMONG EXPERIMENTAL & CONTROL GROUPS**

| Test | High Altitude Training Group | Low Altitude Training Group | Control Group | SOV | SS | Df | MS | F-ratio |
|---|---|---|---|---|---|---|---|---|
| **Adjusted Post-Test Mean** | | | | | | | | |
| Breath Holding Time | 54.26 | 50.13 | 40.05 | **B.M** | 941.90 | 2 | 470.95 | 32.75* |
| | | | | **W.G** | 373.88 | 26 | 14.38 | |
| Resting Heart Rate | 69.86 | 71.45 | 74.34 | **B.M** | 79.62 | 2 | 39.81 | 10.34 |
| | | | | **W.G** | 100.1 | 26 | 3.85 | |
| Vital Capacity | 4.25 | 4.04 | 3.54 | **B.S** | 0.554 | 2 | 0.277 | 15.39* |
| | | | | **W.S** | 0.468 | 26 | 0.018 | |

** Significant at 0.05 level. Table value for df 2, 26 was 3.37.*

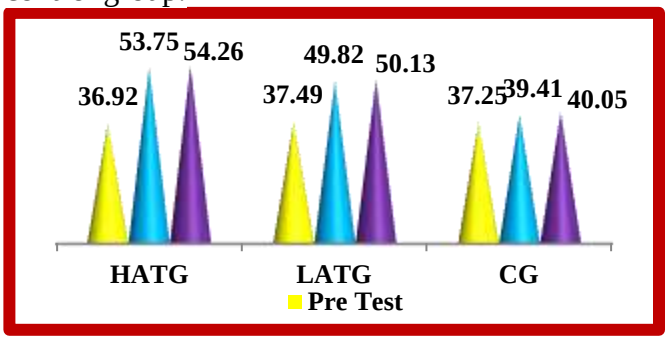
From the table-II shows that the adjusted post-test means values on selected physiological variables such as breath holding time, resting heart rate and vital capacity. The obtained f- ratio for selected physiological variables was 32.75, 10.34 and 15.39 but the required table value of df 2 and 26 was 3.37. It shows that both training groups of adjusted post test mean value was greater than the required table value at 0.05 level of confidence. This results of the study indicated that there was a significant mean difference exist between the adjusted post-test means of high altitude and low altitude trainings and control groups on selected physiological variables. To find out which of the two paired means had a significant difference, the Scheffe's post-hoc test was applied and the results are presented in Table III.

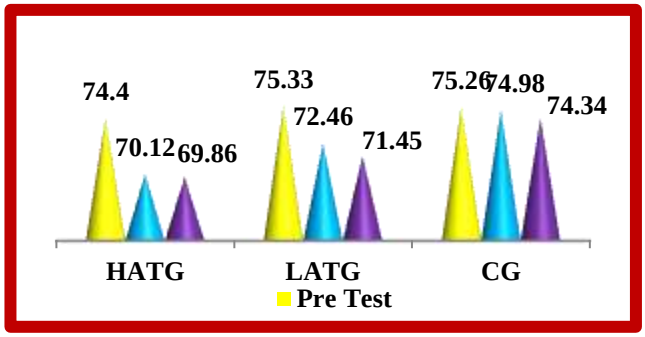
**TABLE III**
**THE SCHEFFE'S TEST FOR DIFFERENCES ON SELECTED PHYSIOLOGICAL VARIABLES BETWEEN THE ADJUSTED POST-TEST PAIRED MEANS**

| Variable | High Altitude Training Group | Low Altitude Training Group | Control Group | Mean Difference | CI |
|---|---|---|---|---|---|
| Breath Holding Time | 54.26 | 50.13 | -- | 4.13* | **3.27** |
| | 54.26 | -- | 40.05 | 14.21* | |
| | -- | 50.13 | 40.05 | 10.08* | |
| Resting Heart Rate | 69.86 | 71.45 | -- | 1.59* | **1.69** |
| | 69.86 | -- | 74.34 | 4.48* | |
| | -- | 71.45 | 74.34 | 2.89* | |
| Vital Capacity | 4.25 | 4.04 | -- | 0.21* | **0.12** |
| | 4.25 | -- | 3.54 | 0.71* | |
| | -- | 4.04 | 3.54 | 0.50* | |

**Significant at 0.05 level of confidence*

From the table III shows that, there was a significant difference on selected performance variables between three groups. It was concluded that the high altitude training group is better than low altitude training group and also the low altitude training group had improving their selected physiological variables among male long distance runners while compared than the control group.



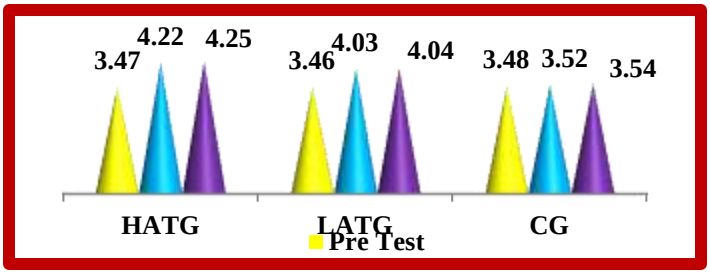



**Figure 1:** Mean value of high altitude training group, low altitude training group and control group on breath holding time, resting heart rate and vital capacity among long distance runners.

**Discussion on Findings**

The result of study indicates that there were significant differences on breath holding time, resting heart rate and vital capacity on high altitude training, low altitude training and control groups of long distance runners. The following studies are supported to the result of this investigation from Strzała, M., Ostrowski, A., & Szyguła, Z. (2011); Ward M, Milledge JS, West JB, Ward MP, (2001); Tong, T. K., Kong, Z., Lin, H., He, Y., Lippi, G., Shi, Q. & Nie, J. (2016) and Płoszczyca, K.; Langfort, J.; Czuba, (2018).

**Conclusions**

On the basis of findings of the study, the following conclusions may be drawn:

The present study was exposed that significant difference was found in the mean of breath holding time, resting heart rate and vital capacity of high altitude training and low altitude training and control groups. The high altitude training group had significantly outperformed than the low altitude training group on the participant's physiological variables. However the control group had not shown any significant improvement on selected dependent variables.

**Conflict of interest :- Nil**

**Sourse of funding :- self**

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