# EFFECTIVNESS OF RESISTANCE AND AEROBIC TRAINING WITH PROTEIN INTAKE ON MAXIMUM OXYGEN CONSUMPTION OF VOLLEYBALL PLAYERS LIVING AT ALTITUDE

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**Abstract**

*The aim of this study was to analyze the effect of resistance and aerobic trainings in combination with protein intake on $Vo_2max$ of volleyball players living at altitude. This study was confirmed to forty eight (N=48) male inter-collegiate level volleyball players studying in various Colleges, in Kashmir region, India as subjects and their age ranged from 18 to 24 years. The volleyball players who represented inter collegiate level competitions and residing at moderate altitude that is 5000-8000 ft (1524-2438 m) above sea level was only considered. The number of groups for the study was delimited to four and designed as resistance training with protein intake (group-I), aerobic training with protein intake (group-II) and combined resistance and aerobic training with protein intake (group-III) groups and control group (group-IV). The number of subjects in each group was confined to twelve. The data collected from the four groups prior to and post experimentation on $Vo_2max$ were statistically analyzed, by paired t test and analysis of covariance (ANCOVA). Then Scheffe's test was applied as post hoc test. In all the cases the level of confidence was fixed at 0.05 level for significance. Intake of protein during resistance training lead to 5.06% of progress, intake of protein during aerobic training lead to 11.67% of progress whereas intake of protein during combined training (resistance & aerobic) lead to 7.60% of progress in $Vo_2max$ capacity of the volleyball players living at altitude.*

***Key words:*** *Resistance and aerobic training, Protein intake, $Vo_2max$, Altitude, Volleyball players*

## INTRODUCTION

Volleyball is one of the most active and exciting sport. Nowadays, it has got a special place among all other ones. In this sport, the presence of aerobic and anaerobic energy and unpredicted fluctuations of biologic needs are observable **(Laconi *et al.*, 1998)**. In the modern world, athletic experts are attempting to utilize new scientific methods to prepare professional athletes at different national and international competitions. Therefore, utilization of the best appropriate methods of training is the most important basis which must be performed by the experienced in professional fields. Nowadays, there is a wide range of scientific research on athletes, competitions and physical training. In this regard, one of the most effective ways in relation to the improvement in athletes' physical energy is resistance and aerobic training.

Resistance and aerobic training produce significantly different or even opposite outcomes. Aerobic training reduces the activity of glycolytic enzymes and increases the number of intracellular energy storages, the activity of oxidative enzymes, the number of capillaries in muscles, and the density of mitochondria **(Forssell, 2015)**. Resistance training, on the other hand, has nearly opposite results to these factors, although both training types increase the number of intracellular energy storages. Moreover, endurance training mostly maintains or even decreases the size of muscle fibers whereas strength training increases **(Tanaka & Swensen, 1998)**. Overall, endurance training increases aerobic processes, and resistance training increases muscle strength, anaerobic processes, and power production. Applying a short but intensive strength training program (up to 6 weeks) can lead to significant changes in some parameters in strength performance, especially in overall strength and neural adaptation. Resistance and endurance training, appears to be quite efficient since most of the studies on athletes regarding combined training have led to positive results in both strength and endurance performances.

Good nutrition is important for optimal athletic performance. In addition to the impact on athletic performance a nutritionally sound diet is essential to both the immediate and the future health of the athletes. Protein plays an important role in the diet of sportsman. Proteins are very complicated molecules. They are truly the physical basis of life, because every function in the living cell of our organism depends on them. Some scientists call this nutrient VIP (Very Important Protein). Its main function is to build up, keep up, and replace the tissues in the body. The organs and even some of the hormones are made up mostly of protein. Protein supplements that provide the amino acids necessary to restore muscle glycogen and rebuild muscle tissue that is damaged during intense, prolonged exercise would be beneficial.

The novelty of the present study is that previous studies compared the effects of resistance training (RT) and aerobic training (AT) between each other. This study compares $VO_2$max between resistance training with protein intake and aerobic training with protein intake in a homogenous group of volleyball players living at altitude. For this reason, the main aim of this study was to evaluate and compare the effects of an intensive workout programme combined with protein supplementations on $VO_2$max. The investigator also wanted to incorporate the combined resistance and aerobic trainings with protein supplementations among volleyball players because of the benefits of this kind of stimulus. These results may be valuable for

effective planning, building, and execution of training with an overall goal to increase the general fitness of volleyball players living at altitude.

## METHODOLOGY

### Subjects and Variable

This study was confirmed to forty eight (N=48) male inter-collegiate level volleyball players studying in various Colleges, in Kashmir region, India as subjects and their age ranged from 18 to 24 years. The volleyball players who represented inter collegiate level competitions and residing at moderate altitude that is 5000-8000 ft (1524-2438 m) above sea level was only considered. The number of groups for the study was delimited to four and designed as resistance training with protein intake (group-I), aerobic training with protein intake (group-II) and combined resistance and aerobic training with protein intake (group-III) groups and control group (group-IV). The number of subjects in each group was confined to twelve. All 3 groups were assessed before and immediately after 12 weeks of training period on Maximum oxygen consumption by conducting Cooper's 12 mts Run/Walk test.

### Training Programme

The experimental group-I performed resistance training with protein intake, group-II performed aerobic training with protein intake, group-III performed combined resistance and aerobic training with protein intake. The experimental groups performed these training three alternative sessions per week for 12weeks. Resistance training involves the following exercises namely military press, bench press, squat, lat pull down, standing calf raise, leg curl respectively. The resistance training program was a total body workout consisting of 3 sets of 6-10 repetitions on 6 exercises that trained all the major muscle groups. A percentage of each subject's one-repetition maximum for each exercise was used to determine the intensity of each week. The intensity (70- 95% of 1RM) and number of repetitions performed for each exercise was progressively increased. The intensity was increased as training progressed.

The experimental group-II performed aerobic training alternatively three days in a week for twelve weeks. In this present investigation continuous running was given to the athletes as aerobic training. To fix the training load for the aerobic group the subjects were examined for their exercise heart rate in response to different work bouts, by performing continuous running of two minutes duration for proposed repetitions and sets, alternating with active recovery based on work-rest ratio. The subject's training zone was computed using Karvonen formula and it was

fixed at 70%HRmax to 95%HRmax. The rest - work ratio of 1:1 in-between exercises and 1:3 between sets was given.

The subjects of experimental group-III performed combined resistance and aerobic training alternatively three days in a week for twelve weeks. The resistance training program was a total body workout consisting of six exercises that trained all the major muscle groups. The resistance training load was fixed based on one repetition maximum (1RM) of each participant. The aerobic training consists of continuous running of two minutes duration for proposed repetitions and sets, alternating with active recovery based on work-rest ratio.

**Protein Supplementation**

The subjects of experimental group-I, II and III was recommended to take protein as designed for them by expert dieticians during the 12-week treatment period. The review of literature shows that 0.8 to 1.5 g/kg protein supplementation is adequate in the players (elite). Based on this 1.2 g/kg protein drinks (solution) was supplemented for subjects half an hour before dinner approximately 7.00 pm for three days during training period. Similarly placebo was given to non supplementation group i.e. (control). The placebo contains sugar (Glucose) solution; which does not have any effect.

**Statistical Procedures**

The collected data was statistically analyzed by paired 't' test. Further, percentage of changes was calculated to find out the alterations in Maximum oxygen consumption due to the impact of experimental treatment. Further, the data collected from the four groups prior to and post experimentation on Maximum oxygen consumption was statistically analyzed to find out the significant difference if any, by applying the analysis of covariance (ANCOVA). Since four groups were involved, whenever the obtained 'F' ratio value was found to be significant for adjusted post test means, the Scheffe's test was applied as post hoc test to determine the paired mean differences, if any. In all the cases the level of confidence was fixed at 0.05 level for significance.

**Results**

The $Vo_2$max data (pre & post) of the chosen four group's volleyball players living at altitude are analyzed by ''t' test, ANCOVA and post hoc test statistics and the derived results are displayed in table- I-III.

**Table-I: Descriptive Statistics and Dependent 't' Test Results on $Vo_2$max Data of the Chosen Four Group's Volleyball Players Living at Altitude**

| Group's Name | Testing Periods | N | Mean Values | SD Values | DM | changes in % | 't' - ratio |
|---|---|---|---|---|---|---|---|
| **Resistance Training with Protein Intake** | Pre | 12 | 32.79 | 2.94 | 1.66 | 5.06% | 5.47* |
| | Post | | 34.45 | 2.31 | | | |
| **Aerobic Training with Protein Intake** | Pre | 12 | 33.15 | 3.74 | 3.87 | 11.67% | 11.57 |
| | Post | | 37.02 | 2.96 | | | |
| **Combined Training with Protein Intake** | Pre | 12 | 33.30 | 3.34 | 2.53 | 7.60% | 6.72 |
| | Post | | 35.83 | 2.50 | | | |
| **Control** | Pre | 12 | 33.31 | 2.06 | 0.04 | 0.12% | 0.18 |
| | Post | | 33.35 | 1.97 | | | |

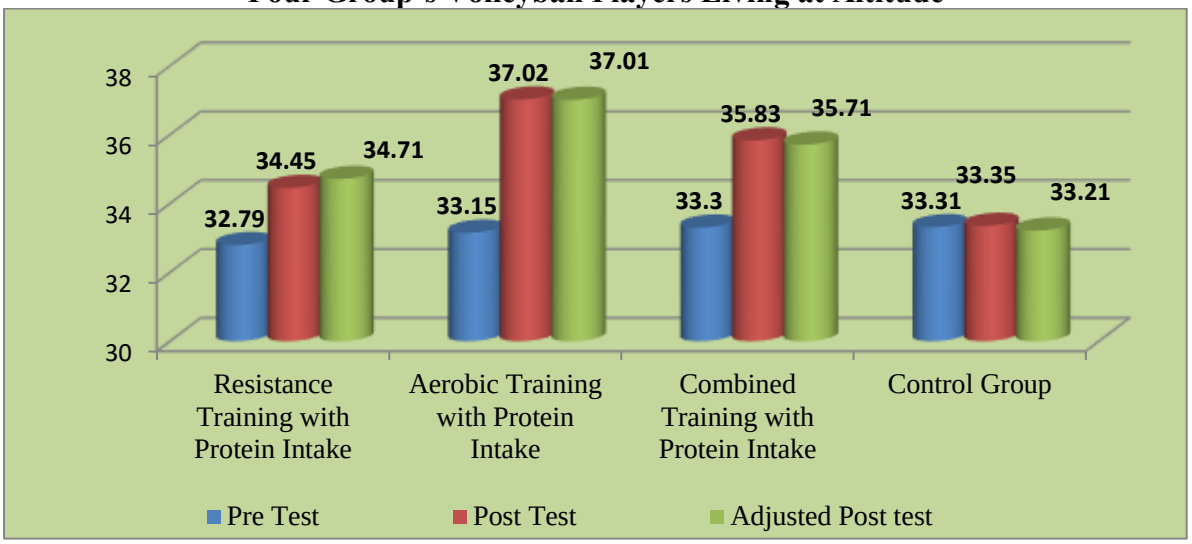
*Table value for df 11 is 2.20(*significant)*

The $Vo_2$max data (pre & post) of the chosen three treatment group's volleyball players living at altitude vary clearly because the dependent 't' test values resistance with protein intake (5.47), aerobic with protein intake (11.57) as well as combined training with protein intake (6.72) groups are more than 2.20 (table value needed for 11 df).

Intake of protein during resistance training lead to 5.06% of progress, intake of protein during aerobic training lead to 11.67% of progress whereas intake of protein during combined training (resistance & aerobic) lead to 7.60% of progress in $Vo_2$max capacity of the volleyball players living at altitude.

The $Vo_2$max data (pre, post &adjusted) of the chosen four group's volleyball players living at altitude are graphically represented in figure-I.

**Figure – I: Figure Showing the $VO_2$max Data of the Chosen Four Group's Volleyball Players Living at Altitude**




The $VO_2$max data (pre&post) of the chosen four group's volleyball players living at altitude are analyzed by ANCOVA statistics and the derived results are displayed in table -III.

**Table – III: ANCOVA Results on $Vo_2$max of the Chosen Four Group's Volleyball Players Living at Altitude**

| Mean | Resistance Training with Protein Intake | Aerobic Training with Protein Intake | Combined Training with Protein Intake | Control Group | S o V | SS | df | MS | 'F' ratio |
|---|---|---|---|---|---|---|---|---|---|
| Adjusted-Post-test | 34.71 | 37.01 | 35.71 | 33.21 | B | 92.65 | 3 | 30.88 | 50.00* |
| | | | | | W | 26.56 | 43 | 0.62 | |

*(Table value for df 3 & 43 are 2.82 )*Significant (.05 level)*

The results derived through the application of ANCOVA statistics proved that the adjusted (post test) means on $Vo_2$max capacity of resistance with protein intake (M=34.71) aerobic with protein intake (M=37.01) combined training with protein intake (M=35.71) and control (M=33.21) groups volleyball players living at altitude resulted in 'F' value of 50.00 which is better to 2.82 (*Table value needed for df 3 & 43* =2.82).

As the adjusted(posttest) means of chosen four group's of volleyball players living at altitude differ from each other on $Vo_2$max, the Scheffe's statistics was applied (table-III).

**Table – III: Post Hoc (Scheffe's) Test Results on $Vo_2$max of the Chosen Four Group's Volleyball Players Living at Altitude**

| Resistance Training with Protein Intake | Aerobic Training with Protein Intake | Combined Training with Protein Intake | Control | MD | CI |
|---|---|---|---|---|---|
| 34.71 | 37.01 | | | 2.30* | 0.93 |
| 34.71 | | 35.71 | | 1.00* | 0.93 |
| 34.71 | | | 33.21 | 1.50* | 0.93 |
| | 37.01 | 35.71 | | 1.31* | 0.93 |
| | 37.01 | | 33.21 | 3.80* | 0.93 |
| | | 35.71 | 33.21 | 2.50* | 0.93 |

**Significant (.05)*

It (Scheffe's test result) established that due to resistance training with protein intake (MD=1.50) aerobic training with protein intake (MD=3.80) combined training with protein intake (MD=2.50) the $Vo_2$max capacity of the volleyball players living at altitude improved to a great extent. However, aerobic training with protein intake group was better than combined training with protein intake (1.31>0.93) and resistance training with protein intake (2.30>0.93) groups. Further, combined training with protein intake group was better than resistance training with protein intake (1.00>0.93) group.

**DISCUSSION**

Due to protein intake with resistance training and aerobic training the $VO_2$max of volleyball players living at altitude altered greatly. The main aim of altitude training is to increase the total volume of red blood cells and haemoglobin mass to improve the limiting link (i.e. oxygen delivery) by increasing the arterial blood oxygen-carrying capacity, and thus increase $VO_2$max and improve performance both at sea level and at altitude. The increase in $VO_2$ max will directly influence the cardiovascular efficiency and hence the improvement in cardiovascular endurance. This finding is in conformation of the findings of **Vargese *et al.*, (2010)**. Normal diet plus HIIT on 4 days per week for 5 weeks under moderate normobaric hypoxia improved more $VO_{2peak}$ **(Kong *et al.*, (2017)**.

Regular aerobic exercise is a well-proven strategy to increase $VO_2$max and endurance performance **(Milanovic, Sporis & Weston, 2015)**, changes underpinned by improved cardiac output and mitochondrial function and vascularity within skeletal muscle tissue **(Lavie *et al.*, 2019)**. In addition, the degree of exercise-induced adaptations can be influenced by nutritional factors such as protein intake **(Hawley *et al.*, 2011)**. Indeed, some research **(Ferguson-Stegall *et***

***al.*, 2011; Knuiman *et al.*, 2019)** has shown further improvements in $VO_2$max following 4.5–12 weeks of post-exercise protein supplementation.

**Ferguson-Stegall *et al.*, (2011)** found a significant difference in $VO_2$max improvement, in normal weight untrained participants following protein-carbohydrate supplementation compared to a placebo control and a carbohydrate only drink. Regarding the mechanism underpinning the cardiovascular improvement, may be an increase in plasma volume could have been achieved by a greater increase in plasma albumin content. Physiological adaptations in response to acute and chronic exposure to hypoxic environments are well-documented and range from short-term detrimental effects necessitating reduced training loads to longer-term adaptations that can improve performance at altitude and in sea-level competitions. Briefly, red blood cell (RBC) and hemoglobin (Hb) content appear to be major factors contributing to (but probably not solely responsible for) increases in maximal oxygen uptake ($VO_2$max) observed after altitude training.

## CONCLUSION

Intake of protein during resistance training lead to 5.06% of progress, intake of protein during aerobic training lead to 11.67% of progress whereas intake of protein during combined training (resistance & aerobic) lead to 7.60% of progress in $VO_2$max capacity of the volleyball players living at altitude. Aerobic with protein intake group was better than combined training with protein intake and resistance training with protein intake groups. Further, combined training with protein intake group was better than resistance training with protein intake group.

Consequently, it can be declared that altitude training produces a physiological stress in human body. People born and raised at high altitudes has adapted and developed modifications, even at genetic level. These adaptations involve different systems and have been compared with those generated by exercise and training. In that sense, altitude acclimatization and training have been used as an additional stimulus to improve performance, both at higher altitudes and at sea level.

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