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Original Article

# Impact of Varied Types of Aerobic and Anaerobic Training on Vital Capacity and $VO_2$ max among Handball Players

**N. R. Ramkumar**

*Department of Physical Education, AMET University, Chennai, Tamil Nadu, India*

## ABSTRACT

The aim of this study is to find out the impact of varied types of aerobic and anaerobic training on vital capacity among handball players. 45 male handball players studying different colleges in Madurai District were divided into three groups, namely, series (continuous) aerobic and anaerobic training group (STG) and parallel (alternate) aerobic and anaerobic training group (PTG) and control group (CG). The STG group was given aerobic training continuously for first 8 weeks and anaerobic training for next 8 weeks. The PTG group was experimented with aerobic training and anaerobic training alternately for 16 weeks. Aerobic training for both the groups was running at 50-60% of maximum heart rate for 40 min. Anaerobic training consisted of short sprint (running at 90-100% heart rate duration 3 min) and eight weight-training exercises. The ANCOVA results showed that STG and PTG significantly improved $VO_2$ max and vital capacity *post hoc* analysis proved that PTG was better than STG and the differences were significant at 0.05 level ($P < 0.05$). Although STG and PTG improved vital capacity comparing to CG; there was no significant difference between STG and PTG. It was concluded that parallel aerobic and anaerobic training are better than series training in improving cardiopulmonary fitness variables, $VO_2$ max and vital capacity of handball players.

**Address for correspondence:**
N. R. Ramkumar, Department of Physical Education, AMET University, Chennai, Tamil Nadu, India.
E-mail: ram.sportive@gmail.com

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## INTRODUCTION

Development of lower-body explosive power is important for virtually every sport.[1] Effective plyometric training can lead to rapid improvements in explosive power.[2] When done incorrectly, fatigue may lead to incorrect technique, unnecessary exposure to injury overreaching and overtraining.[3] Establishing a training volume for explosive power development is a complex task, and the best approach is often debated among strength and conditioning coaches,[4,5] for both short-[6] and long-term power improvements.[7] Training volume can be altered in a number of ways: Varying reps in a set, resistance in rep, number of sets, and frequency of training.[8] Several investigators have examined the number of sets for resistance training to develop strength.[7,9] Set number has also been studied with plyometric training for developing power.[1,10] However, training volume varied by set number has not been investigated for resistance-loaded plyometric training in novice athletes.

## METHODOLOGY

To achieve the purpose of this study, 45 male handball players studying different colleges in Madurai District Chennai were selected randomly as the subjects, and their age ranged between 18 and 21 years. The selected subjects were divided into three groups, namely, series (continuous) aerobic and anaerobic training group (STG) and parallel (alternate) aerobic and anaerobic training group (PTG) and control group (CG) consisting of 15 handball players in each group. The experimental period was 16 weeks. The STG group was given aerobic training continuously for first 8 weeks and anaerobic training for next 8 weeks. The PTG group was experimented with aerobic training and anaerobic training alternately for 16 weeks. Aerobic training for both the groups was running at 50-60% of maximum heart rate for 40 min. Anaerobic training consisted of short sprint (running at 90-100% heart rate duration 3 min) and eight weight-training exercises. The CG was not exposed to any treatments and was strictly under control. The selected cardiopulmonary fitness variables, $VO_2$ max and vital capacity of the subjects of all the three groups were measured through standard tests before the experimental period and after the experimental period. The difference between the initial and final means on selected variables was the influence of series and parallel type of aerobic and anaerobic training on selected cardiopulmonary fitness variables. The obtained data were subjected to statistical

**Table 1:** Results on calculation of analysis of covariance on cardiopulmonary fitness variables among experimental and CGs

| Mean | STG | PTG | CG | Source of variance | Sum of squares | df | Mean squares | Obtained *F* |
|---|---|---|---|---|---|---|---|---|
| Calculation of analysis of covariance on $VO_2$ max | | | | | | | | |
| Pre-test mean | 41.87 | 40.29 | 40.94 | Between | 19.0 | 2 | 9.52 | 0.50 |
| Standard deviation | 4.73 | 3.82 | 4.52 | Within | 803.3 | 42 | 19.13 | |
| Post-test mean | 44.75 | 46.16 | 41.16 | Between | 198.8 | 2 | 99.40 | 6.07* |
| Standard deviation | 4.06 | 4.25 | 3.82 | Within | 687.7 | 42 | 16.37 | |
| Adjusted post-test mean | 44.12 | 46.71 | 41.23 | Between | 224.5 | 2 | 112.23 | 18.84* |
| | | | | Within | 244.2 | 41 | 5.96 | |
| Mean difference | 2.87 | 5.87 | 0.22 | | | | | |
| Calculation of analysis of covariance on vital capacity | | | | | | | | |
| Pre-test mean | 2118.67 | 2046.00 | 2126.00 | Between | 58,671.1 | 2 | 29,335.56 | 0.62 |
| Standard deviation | 264.46 | 218.92 | 155.37 | Within | 1,988,093.3 | 42 | 47,335.56 | |
| Post-test mean | 2278.00 | 2296.00 | 2144.00 | Between | 206,920.0 | 2 | 103,460.00 | 2.10 |
| Standard deviation | 278.16 | 218.92 | 149.03 | Within | 2,065,160.0 | 42 | 49,170.48 | |
| Adjusted post-test mean | 2258.12 | 2342.45 | 2117.43 | Between | 379,981.1 | 2 | 189,990.56 | 19.06* |
| | | | | Within | 40,8621.1 | 41 | 9966.37 | |
| Mean difference | 159.33 | 250.00 | 18.00 | | | | | |

Required $F_{(0.05, 2.42)}$=3.22. *Significant. STG: Series training group, PTG: parallel training group, CG: Control group

**Table 2:** Scheffe's *post hoc* analysis results

| STG | PTG | CG | Mean difference | Required CI |
|---|---|---|---|---|
| *Post hoc* analysis for $VO_2$ max | | | | |
| 44.12 | 46.71 | | 2.59* | 2.27 |
| 44.12 | | 41.23 | 2.89* | 2.27 |
| | 46.71 | 41.23 | 5.48* | 2.27 |
| *Post hoc* analysis for vital capacity | | | | |
| 2258.12 | 2342.45 | | 84.33 | 92.51 |
| 2258.12 | | 2117.43 | 140.69* | 92.51 |
| | 2342.45 | 2117.43 | 225.03* | 92.51 |

*Significant

treatment using ANCOVA. In all cases, 0.05 level was fixed to test the hypothesis of this study.

## RESULTS

The obtained results proved that 16 weeks STG and PTG have been significantly improved cardiopulmonary fitness, $VO_2$ max ($P < 0.05$) as the obtained values were greater than the required *F* value of 3.22 required to be significant at 0.05 level. The *post hoc* analysis proved that the paired differences of means between STG and CG, PTG and CG were significant. It was also found that PTG was significantly better than STG in improving $VO_2$ max.

The obtained results on cardiopulmonary fitness variable, vital capacity proved that 16 weeks STG and PTG have been significantly improved cardiopulmonary fitness, vital capacity ($P < 0.05$) as the obtained $F = 19.05$ on adjusted post-test mean values were greater than the required $F = 3.22$ required to be significant at 0.05 level. The *post hoc* analysis proved that the paired differences of means between STG and CG, PTG and CG were significant.

## DISCUSSIONS

The results indicated that there was a significant increase in $VO_2$ max and vital capacity values after series and parallel aerobic and anaerobic exercise program. Although there was a significant difference between the treatment groups, in favor of PTG on $VO_2$ max, there was no significant difference between the two groups after training in vital capacity. Carsten *et al*. (2004) agreed with this result as they explain the significant increase in $VO_2$ max is related to the effect of exercise either aerobic or anaerobic improve the respiratory function as vital capacity, inspiratory reserve volume and expiratory reserve volume of the lungs, also the stroke volume of the heart

increase by regular exercise. These respiratory adaptations facilitate oxygen supply to tissues and add further evidence to the improvement of the respiratory fitness. Furthermore, Tomohiro *et al*. (2003) confirmed this results as he reported that moderate intensity exercise have a significant increase in $VO_2$ max as well as participating in bouts of high-intensity anaerobic exercise

## CONCLUSIONS

Series and parallel aerobic exercise improve cardiopulmonary fitness in handball players while anaerobic exercise increases cardiac work. Hence, parallel aerobic and anaerobic training may be used best to improve the cardiopulmonary fitness of handball players.

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