

Effect of Concurrent Complex Training and Aerobic Training on Anaerobic Power of College Handball Players

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Abstract

The purpose of study was to find out the effect of concurrent complex training and aerobic training on anaerobic power of college handball players. To achieve this purpose of the study, forty five collegiate men handball players from affiliated colleges of Alagappa University, Karaikudi, were randomly selected as subjects. The age of the subjects ranged between 18 and 25 years. They were divided into three equal groups. The experimental group-1 (n=15, COM.T (a) AT, underwent complex training after aerobic training, the experimental group-2 (n=15, COM.T (b) AT) underwent complex training before aerobic training, and group 3 served as control group (n=10, CG) did not undergo any specific training. The anaerobic power was selected as criterion variable and the measurement was recorded in watts. The selected two treatments were performed 3 days in a week for the period of twelve weeks, as per the stipulated training program. The collected pre and post data was critically analysed with apt statistical tool of one-way analysis of co-variance, for observed the significant adjusted post-test mean difference of three groups. The Scheffe's post hoc test was used to find out pair-wise comparisons between groups with. To test the hypothesis 0.05 level of significant was fixed in this study.

Keywords: Complex Training, Aerobic Training, VO₂ Max, Step Test, Ancova.

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INTRODUCTION

Complex training occurs when the athlete alternate weight training and plyometric within the same workout session. The athlete may also experience a quicker rise in performance when doing this form of training; this makes it extremely useful for athletes who have a shorter time to prepare for competition because of their scheduling (eg, professional tennis players). Combining strength movement exercises with speed movements (such as the depth jump, double-leg hop, or standing triple jump can be a very effective way to stimulate the neuromuscular system and provide variety for the athlete. The arousal mechanism that is stimulated with maximum or near maximal lifting, and the athlete can take advantage of this situation when using plyometric exercises as well. The body appears to remain in this arousal or heightened state of excitement for a short window of time at the conclusion of a heavy set. By immediately adding a plyometric activity, the athlete can take advantage of this physiological state and use it to perform higher-quality plyometric drills. This type of training is an advanced form and works best for athletes

who have a training base and history to fall back on. Proper execution of the lifts and the jump drills is extremely important, and this is the wrong time try to teach basic lifting techniques (Chu, 2013). Aerobic training is a rhythmic, continuous activity that increases heart rate and oxygen consumption, strengthening the cardiovascular system and improving endurance. It involves large muscle groups in exercises like running, swimming, or cycling, with recommended weekly goals of 150 minutes of moderate or 75 minutes of vigorous activity to boost overall fitness and health.

METHODOLOGY

To achieve this purpose of the study, forty five collegiate men handball players from affiliated colleges of Alagappa University, Karaikudi, were randomly selected as subjects. The age of the subjects ranged between 18 and 25 years. They were divided into three equal groups. The experimental group-1 (n=15, COM.T (a) AT, underwent complex training after aerobic training, the experimental group-2 (n=15, COM.T (b) AT) underwent complex training before aerobic training, and group 3 served as control group (n=10, CG) did not

undergo any specific training. The anaerobic power was selected as criterion variable and the measurement was recorded in watts. The selected two treatments were

performed 3 days in a week for the period of twelve weeks, as per the stipulated training program.

Table I: The Results of Analysis of Covariance on Anaerobic Power of Different Groups

Test Conditions		Ex-1 COM.T(A)+ AT	Ex-1 COM.T(B)+ AT	Gr-3 CG	SV	SS	Df	MS	'F' ratio
Pre test	M	793.33	791.67	792.07	B	22.711	2	11.36	0.01
	S.D.	42.36	43.54	33.05	W	66959.60	42	1594.28	
Post test	M	857.40	828.40	796.67	B	27680.73	2	13840.47	8.50
	S.D.	43.20	43.30	33.81	W	68382.27	42	1628.15	
Adjusted Post test	M	856.45	829.00	796.95	B	26600.04	2	13300.0222	113.05
					W	48.23.55	41	117.65	

*Significant at .05 level of confidence. The required table's value for test the significance was 2.87 and 2.87 with the df of 3 and 36, 3 and 35.

RESULTS OF MAX

The pre-test mean and standard deviation on anaerobic power scores G1, G2, and G3 were 793.33 ± 42.36 , 791.67 ± 43.54 , and 792.07 ± 33.05 , respectively. The obtained pre-test F value of 0.01 were lesser than the required table F value 2.87. Hence the pre-test means value of complex training after aerobic training, complex training before aerobic training before start of the respective treatments were found to be insignificant at 0.05 level of confidence for the degrees of freedom 2 and 42. Thus this analysis confirmed that the random assignment of subjects into three groups were successful. The post-test mean and standard deviation on anaerobic power scores G1, G2, and G3 were 857.40 ± 43.20 , 828.40 ± 43.30 , and 796.67 ± 33.81 ,

respectively. The obtained pre-test F values of 8.50 were lesser than the required table F value 2.87. Hence the pre-test means value of complex training after aerobic training, complex training before aerobic training before start of the respective treatments were found to be insignificant at 0.05 level of confidence for the degrees of freedom 2 and 42. Thus this analysis confirmed that the random assignment of subjects into three groups were successful. The adjusted post-test means on anaerobic power scores of G1, G2, G3 and G4 were 856.45, 829.00 and 796.95 respectively. The obtained adjusted post-test F value of 113.05 was higher than the required table F value of 2.87. In order to find out the superiority effects among the treatment and control groups the Scheffe's post hoc test were administered. The outcomes of the same are presented in the table II.

Table II: The Results of Scheffe's Post Hoc Test Mean Differences on Anaerobic Power among the Groups

Ex-1 COM.T(A)+ AT	Ex-1 COM.T(B)+ AT	Gr-3 CG	Mean Differences	CI Value
856.45	829.00	-----	27.45*	0.96
856.45	-	796.95	59.70*	
-----	829.00	796.95	32.25*	

*Significant at .05 level of confidence.

Result of Scheffe's Post Hoc Test on Cardio Respiratory Endurance

Table II shows the paired mean differences of complex training after aerobic training and complex training before aerobic training, complex training after aerobic training and control group, complex training before aerobic training and control group. The results clearly indicated that all two training have produced a significant improvement on anaerobic power than the control group. However the superior of effect has noticed on complex training after aerobic training.

DISCUSSIONS

The 12 weeks of selected trainings has produced a statistically significant improvement on anaerobic power of collegiate handball players. The

following studies in line with the current study. Milosevic, M *et al.*, (2025), their study observed the effectiveness of Super High-Intensity Continuous Training (SHCT) on aerobic performance in elite handball players. The study suggests strong potential for integrating SHCT into elite athletic conditioning programs. Further research is recommended to validate and expand upon these findings. Kumar, G., & Pandey, V. (2023), their study examined the impact of complex training on both aerobic and anaerobic power among amateur athletes. Findings revealed a significant enhancement in anaerobic power and VO_2 max in the experimental group, whereas the control group showed improvement only in aerobic capacity. Notably, no meaningful change in anaerobic performance was observed in the control group. These results highlight the

effectiveness of complex training in improving anaerobic power. The study provides practical implications for coaches aiming to enhance performance in team sports. Hammami, M *et al.*, (2022), their study surveyed the effects of a 10 week complex strength training program with elastic bands on fitness components in young female handball players. These findings highlight the effectiveness of elastic band based complex training in enhancing multiple fitness components. The study provides valuable insights for incorporating resistance-based methods into youth athletic training programs. Chaabene, H *et al.*, (2021), their study investigated the effects of balance training combined with complex training compared to complex training alone on physical fitness in young elite female handball players. These results indicate that combining balance exercises with complex training can provide additional benefits depending on training goals. The study offers practical insights for designing sport-specific conditioning programs. Comyns, T. M (2006), their study explored the influence of intracomplex rest intervals on countermovement jump performance following heavy resistance exercise. Using a repeated measures design, participants performed CMJs under varying rest intervals ranging from 30 seconds to 6 minutes. The results highlight that the effectiveness of complex training is highly dependent on rest interval selection. Importantly, the study emphasizes the need for individualized rest prescriptions to optimize performance outcomes. Bari, M. A *et al.*, (2023), their study examined the effects of a 12-week aerobic training program on liver function in male football players. These findings highlight the potential benefits of aerobic training in supporting liver health. The study suggests that regular aerobic exercise can contribute to maintaining optimal physiological function in athletes. Park, S. Y., & Kwak, Y. S. (2016), their study investigated oxidative stress and antioxidant capacity among aerobically trained, anaerobically trained, and untrained individuals. These results indicate that both aerobic and anaerobic training enhance the body's against exercise-induced oxidative stress. The study highlights the role of regular training in improving redox balance and physiological resilience. Harrison, C. B., Gill, N. D., Kinugasa, T., & Kilding, A. E. (2015), their study reviewed existing literature to determine effective aerobic fitness training strategies for youth team sport athletes across different developmental stages. The findings emphasize a progressive, stage-specific approach to aerobic conditioning in young athletes. This review provides a practical framework for coaches to optimize long-term athletic development. Guo, J., Lou, Y., Zhang, X., & Song, Y. (2015), their study evaluated the effects of moderate intensity aerobic exercise on cardio metabolic health in heavy weight professional athletes. These results highlight the effectiveness of aerobic exercise in improving cardio metabolic health even in strength-trained athletes. The study underscores the importance of integrating aerobic conditioning for overall health and performance benefits. Arazi, H., Benar, N., Esfanjani, R. M., & Yeganegi, S.

(2012), their study investigated the effects of aerobic training on stress, anxiety, and depression among non-athlete female students. These findings highlight the positive psychological benefits of aerobic training. The study suggests that aerobic exercise can be an effective strategy for improving mental well-being.

CONCLUSIONS

- 1) Both training interventions namely complex training after aerobic training and complex training before aerobic training have produced the statistically significant improvement on anaerobic power than the control group.
- 2) The complex training after the aerobic training has produced greater improvements on anaerobic power than the other training group.
- 3) The complex training before aerobic training has produced a least development of anaerobic power than the control group.
- 4) No changes observed in the control group on anaerobic power.

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