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Effect of intensive and extensive interval training on maximal oxygen uptake (Vo_2 max) among kho-kho players

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Abstract
The purpose of the study was to find out the effect of intensive and extensive interval training on maximal oxygen uptake (Vo_2 max) among kho-kho players. To achieve the purpose of the study, thirty male Kho-Kho players studying varies department, Annamalai University, Chidambaram, Tamil Nadu, India, were randomly selected and divided into three groups of ten each. The age of the subjects, ranged from 18 to 25 years. This study consisted of two experimental variables intensive interval training and extensive interval training. The allotment of groups was done at random, thus Group-I underwent intensive interval training, Group-II underwent extensive interval training for three days per week for twelve weeks, Group-III acted as control. The selected dependent variable was maximal oxygen uptake (Vo_2 max) and was appraised using methods and instruments of scientific standards. The experimental groups underwent their respective training programme for three days a week for twelve weeks. To statistically analyse the changes on criterion variables, 'ANCOVA' and Scheffé S test were used. The analysis of data revealed significant improvement on selected criterion variables as a result of experimental treatments. while extensive interval training maximal oxygen uptake (Vo_2 max). These results suggest that interval training of varied intensity may be adopted according to the need of the player.

Keywords: Intensive interval training, extensive interval training, maximal oxygen uptake (Vo_2 max)

Introduction

Interval training is a method of practice used by runners in which an athlete runs at specified paces for specified periods of time, followed by a rest break in which a runner walks or jogs. This method helps to take rest between the repeated runs. Even experienced runners mistakenly refer the repeated distance runs as the interval, but the rest in between repetitions is the interval. The rest interval, repeated distance run, number of repeats, running speed and total distance run are all quantified and these parameters can be changed to achieve certain desired training effects. The physiological factors of aerobic endurance performance include maximal oxygen consumption (VO2max) lactate threshold and running economy (Basset and Howley 2000) [2]. Long-term performance development needs to sufficient training volume and intensity to progressively overload and stress these physiological factors (Midgley *et al.* 2006) [5]. Adaptive responses to training designed to enhance a particular physiological performance are the determinants of training period. The relative importance of other physiological performance determinants influences the specific training method chosen to target aerobic endurance enhancement (Zinner 2016) [10]. There are many types of four- to ten-week training such as long slow distance training, fartlek running, cross-country training, extensive and intensive interval training, lactate threshold training to enhance cardiorespiratory efficiency for aerobic endurance performance. Training with these different methods is necessary to reach aerobic endurance levels related to specific sport events. Midgley *et al.* (2007) [5] stated that scientists had very small contributions about current training methods developed predominantly from the trial-and-error approach of distance runners by several authority coaches. Although the aim of the traditional training methods, interval training and cross-country training, was to increase cardiorespiratory efficiency in the endurance training, which one is the better effective training method to enhance aerobic endurance performance is still unclear. The duration of basic endurance training varies from one hour to several hours, and the intensity of long duration training should be 60-80% of VO_2max Whereas, the high intensity endurance training is designed to develop respiratory and circulatory functions, the oxidative and glycolytic capacities of the muscles, and the elimination of lactic acid from the muscles. Thus variation in intensity between the aerobic and anaerobic thresholds, and the duration of the bout depends on its nature of motor quality to be developed. These two fundamental training for higher aerobic capacity are very important for quick recovery especially in the preparatory phase in the annual training plan. Preparatory training phase should include several months of base training at intensities of 65 to 70 percent VO2max (Hawley 1995) [3]. Hence, the purpose of the present study was to assess the effect of intensive and extensive interval training on Vo_2 max among Kho-Kho players.

Methods and Procedures

The purpose of the study was to find out the effect of intensive and extensive interval training on maximal oxygen uptake (Vo_2 max) among Kho-Kho players. To achieve the purpose of the study, thirty male Kho-Kho players studying varies department, Annamalai University, Chidambaram, Tamil Nadu, India, were randomly selected and divided into three groups of ten each. The age of the subjects, ranged from 18 to 25 years. This study consisted of two experimental variables intensive interval training and extensive interval training. The allotment of groups was done at random, thus Group-I underwent intensive interval training, Group-II underwent extensive interval training for three days per week for twelve weeks, Group-III acted as control. The selected dependent variable selected was maximal oxygen uptake (Vo_2 max) and was assessed by Cooper test formula

$$Vo_2\,max = \frac{d_{12} - 504.9}{44.73}$$

The data were collected before and after the twelve weeks of intensive and extensive interval training. The experimental groups underwent their respective training and were performed at constant speed that lasted from 30 to 60 minutes. A number of shorter bursts were performed at various levels of heart rate, and the duration that varied from few tenths of a second to a few minutes with appropriate recovery. VO_2max is generally accepted as a measurement of cardio-respiratory endurance and it is an important characteristic of physical fitness due to its high correlation with health and health risks [Wilder *et al*, (2006)] [9].

Exercise training protocol

The exercise training program of both the experimental groups [intensive interval training (IIT; 80-90% H Rmax) and extensive interval training (EIT; 60 - 70% of their maximum heart rate-H Rmax), consisted of sprinting for distance in time and then jogging or walking for a short period that allows incomplete recovery of the heart rate. The subjects confined to both the experimental groups trained thrice a week for twelve weeks, while the control group was not exposed to any specific training programme. During every second week of the training program one repetition is increased additionally on a particular training intensity. Further, the prescription of exercise allows two weeks of stabilization to a training intensity, and thereafter the time limit to execute the exercise was reduced so as to increase the intensity of exercise. The training schedule prescribed to both the experimental groups was as given in Table-I

Table1: Training Schedule

Experimental Groups	Training Distance		I&II Week	III&IV Week	V&VI Week	VII&VIII Week	IX&X Week	XI&XII Week	Repetition	Recovery Duration
	Day	In Meters	In Second	In Second	In Second	In Second	In Second	In Second	In Numbers	In Second
Intensive Interval Training	Mon	100	15	14.65	14.3	14	13.6	13.3	7 to 8	120
	Wed	200	45	44	43	42	41	40	6 to 7	180
	Fri	400	100	98	96	94	92	90	4 to 5	240
Extensive Interval Training	Mon	100	18	17.65	17.3	17	16.6	16.3	10 to 11	60
	Wed	200	50	49	48	47	46	45	8 to 9	90
	Fri	400	110	108	106	104	102	100	6 to 7	120

Statistical Techniques

Random group design involving thirty subjects segregated into two experimental groups and one control group was used for the purpose of the study. To statistically analyse the changes on criterion variable, 'ANCOVA' and Scheffé S test were used. The level of significance was accepted at $P<0.05$.

Result of the study

Analysis of covariance for pre and post test data on maximal oxygen uptake (vo2 max) of intensive and extensive interval training groups and control group

	Group I	Group II	Group III	Source of variance	Sum of Squares	df	Mean squares	'F' ratio
Pretest Mean SD	42.87	43.25	43.23	Between	0.915	2	0.458	0.94
	2.37	2.12	2.08	Within	130.94	27	4.85	
Posttest Mean SD	47.95	53.26	43.32	Between	495.09	2	247.54	62.48*
	2.35	1.60	1.93	Within	106.96	27	3.96	
Adjusted Posttest Mean	48.12	53.17	43.24	Between	492.83	2	246.41	146.59*
				Within	43.70	26	1.68	

* Significant at 0.05 level of confidence. The table value required for significance at 3.37

The adjusted post-test mean on maximal oxygen uptake (Vo_2 max) for intensive interval training group is 48.12, extensive interval training group is 53.17 and control group is 43.24. The obtained 'F' ratio of 146.59 for adjusted post-test mean is more than the table value of 3.37 required for significance at 0.05 level for DF 2 and 26. The results of the study showed that there was significant difference among three groups on maximal oxygen uptake (Vo_2 max).

Table 2: Scheffe's Post Hoc Test for the adjusted post-test paired mean differences on maximal oxygen uptake (vo2 max)

adjusted posttest Means				Confidence Interval
Intensive Interval Training Group	**Extensive Interval Training Group**	**Control Group**	**Mean Difference**	
48.12	53.17		5.05*	1.50
48.12		43.24	4.88*	1.50
	53.17	43.24	9.93*	1.50

*significant at 0.05 level of confidence.

The table II shows that the adjusted posttest paired mean difference between intensive interval and extensive interval training, intensive interval and control group and extensive interval and control group are 5.05, 4.88 and 9.93 for muscular strength respectively. All the three are higher than the confidence interval of 1.50 required for significance at 0.05 level of confidence. It is inferred that the twelve weeks of intensive interval training and extensive interval training groups have significantly increased the maximal oxygen uptake (Vo_2 max) as compared to the control group. The result also reveals that the increase in maximal oxygen uptake (Vo_2 max) is significantly more for extensive interval training group as compared to intensive interval training group.

Discussion on Findings

The result of the present study has showed that maximal oxygen uptake (Vo_2 max) improved for both intensive interval training and extensive interval training groups as compared to control group. However extensive interval training group was found to be significantly better than intensive interval training group in the improved maximal oxygen uptake (Vo_2 max). These variables have high association with force generation. The force generation depends upon motor unit activation. Interval training normally improves force generating capacity through activation of numerous neuromuscular mechanisms. These factors might have contributed for better performance in the maximal oxygen uptake (Vo_2 max) variable for both EITG and IITG as compared to CG. Substantial and beneficial gains in maximal oxygen uptake (Vo_2 max) have been reported in most of the studies conducted earlier. The results of the present study are also in line with the results observed from the previous studies. Saltin *et al*. (1995) [8]'study result that untrained Kenyan males (14.2 ± 0.2 year) had a mean VO2max of 47.0 (44.0-51.0) kg.ml.dk-1. Another study (Larsen *et al*. 2004) also confirms the results of this study about VO2max males of mean age 16.6 year from town setting attaining a mean VO2max of 50.0 (45.0-60.0) kg.ml.dk-1. Post test results of the present study showed that VO2max was 57.8 ± 3.8 kg.ml.dk-1 in ETG and 51.7 ± 3.1 kg.ml.dk-1 in CTG. Although the results of this study supported Bacon *et al*. (2013) [1] meta-analysis study that interval training increased VO2max (%10.3; ES: -1.40; from 52.4 ± 3.9 kg.ml.dk-1 to 57.8 ± 3.8 kg.ml.dk-1), Midgley *et al*. (2006) [6] explained that there was a little evidence as to which training intensity is most effective in enhancing VO2max but extensive interval training and cross-country training intensities of 40–50% VO2max can increase VO2max substantially in untrained individuals. They also stated these lower training intensities induce such adaptations that increased in maximal stroke volume, skeletal muscle capillarity, myoglobin concentration, and oxidative capacity of skeletal muscle fibers because the physiological stress can be imposed for longer periods. Koçal *et al* (2016) [7] explained that there was a demonstrated that extensive interval training and cross-country training with eight-week, three times a week associated with the enhancement of the shuttle run performance and VO2max. In conclusion, interval training and cross-country training may be practical for the aerobic endurance development but extensive interval training provides all the better for it in the general preparation phase of annual training periodization. From this point of view, middle and long distance coaches may use 1000m to 4000m interval running for the more aerobic performance development in novice young athletes.

Conclusions

The analysis of data revealed significant improvement on selected criterion variable as a result of experimental treatments maximal oxygen uptake (Vo_2 max) improved for both intensive interval training and extensive interval training groups as compared to control group. However extensive interval training group was found to be significantly better than intensive interval training group in the improved maximal oxygen uptake (Vo_2 max). These results suggest that interval training of varied intensity may be adopted according to the need of the motor quality to be developed by the player.

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