

Effect of an iso-intense continuous and intermittent training programme on $\dot{V}O_2$ max and anthropometric profile of sedentary males

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Abstract - The purpose of this study was to investigate the effectiveness of an iso-intense continuous and intermittent training program on maximum aerobic capacity ($\dot{V}O_2$ max) and other anthropometric profiles, like, body mass index (BMI) and fat mass of sedentary males. 24 healthy sedentary males of 21.8 ± 3.7 years participated in this study. They were divided into 3 groups, like, control group (n=9), continuous training group (n=7) and intermittent training group (n=8). Exercise group performed the training 3 days per week up to 12 week. The study was approved by ethical committee of the Universiti Sains Malaysia, Kubang Kerian, Kelantan, Malaysia. $\dot{V}O_2$ max of each individual was determined following a graded exercise protocol to exhaustion, on an Excalibur Lode Cycle ergometer. For continuous exercise, subjects cycled at 60% of individual $\dot{V}O_2$ max for 45 minute on an ergometer. In intermittent training, the subjects cycled at 45% of individual $\dot{V}O_2$ max for 10 min followed by 5 min rest and then at 75% of individual $\dot{V}O_2$ max for 10 min followed by 5 min rest. This repetition continued until 45 min. Both the training programme were made iso-intense. The relative $\dot{V}O_2$ max of both the continuous and intermittent training groups improved significantly, but the degree of improvement was more in intermittent training programme. No improvement was observed in BMI. Regular physical activity is a part of healthy lifestyle that is known to reduce risk of cardiovascular disease. Hence, in conclusion, our study indicated a beneficial effect of exercise training in improving the cardiorespiratory fitness ($\dot{V}O_2$ max), through continuous and intermittent training programme.

Introduction

The beneficial effects of exercise on physiological variables are well known. However, there are many types of aerobic exercise training. Continuous type of training is defined as a long session with low intensity but without any break, whereas, intermittent exercises are defined as short bout sessions of moderate intensity exercise with rest or low intensity activity in between (Hardman, 2001). Most people consider long and continuous workouts to be beneficial for maintaining cardiovascular fitness. However, exercising with intervals may be more effective (Lyndon et al., 2005). In addition, the National Institute Health (NIH) and Health and Human Service (HHS) suggested that shorter bouts of intermittent exercise of moderate intensity with at least 10 minutes duration accumulating 30 minutes per day, provided cardiovascular benefits (Lyndon et al., 2005). DeBusk et al. (1990) compared both intermittent and continuous types of exercise training comprising of same energy expenditure. They observed that, subjects who exercised in intermittent sessions experienced gain in physical fitness and improvement in blood lipid profile. Short bouts of exercise less than 6 minutes lead to a significant improvement in cardiovascular fitness as compared to the longer continuous bout of similar duration (McFarlane et al., 2006). On the other hand, brisk walking training programme at 70-80% of predicted maximal heart rate for 30 min/day on 5 day/ week showed increasing aerobic fitness, improved blood lipid profiles, enhancing the aspects of physiological well-being of sedentary middle-aged adults (Murphy et al, 2002). Regular physical activity reduces the risk of cardiovascular disease and thromboembolism stroke (Haskell et al., 2007).

Previous studies exhibited that the short intermittent bouts of walking provided improvement in aerobic fitness, body composition, plasma lipoprotein and blood pressure compared to continuous or long session of physical training (Haskell et al., 2007). Several studies and investigations evaluated the effects of different types of exercise condition on the haemostatic variables (De Paz et al., 1992). However, studies on the effects of an iso-intense continuous and intermittent exercise training programs on cardio-respiratory variables, like $\dot{V}O_2$ max are scanty in literature. Hence, the present study was undertaken with a view to investigate the effectiveness of an almost similar intensity continuous and intermittent exercise training programme on body composition and $\dot{V}O_2$ max of sedentary individuals.

Materials and Methods

Study Design

A randomized control trial was designed to compare the effects of continuous and intermittent exercise training program on platelet activation and fibrinolytic profile among healthy males. Subjects were divided into three groups (control, continuous and intermittent). Continuous and intermittent group followed their 12 weeks training programs. The control group did not perform any exercise and maintained their sedentary lifestyle during the 12 week intervention period. The complete protocol of the research study has been illustrated in Figure 1, in the form of a flow chart.

This study was approved by the Research and Ethics Committee (Human), Universiti Sains Malaysia, Health Campus, Kelantan. Written informed consent was obtained during the first screening visit.

The inclusion criteria were sedentary males who had not participated or trained regularly in any sport activities, had body mass index (BMI) in the range of 19-25kg/m², non-smoker, had normal blood pressure (< 140/90mmHg), had normal fasting total cholesterol level (<200mg/dl or 5.2mmol/L), normal fasting triglycerides level (<200mg/dl or 2.3mmol/L) and normal blood glucose (70-100mg/dl or 3.9-5.6 mmol/L).

The exclusion criteria included, on drug treatment (Aspirin, Non-steroidal anti-inflammatory drug), high blood pressure (> 140/90mmHg), high blood glucose (> 5.6mmol/L), high level of lipid profile (\geq 5.2 mmol/L), BMI exceeding 25 kg/m², Suffering from chronic disease such as diabetes mellitus, cardiovascular disease, chronic migraine and orthopaedics problems that would interfere with exercise training.

Sample Size Calculation

The sample size was calculated using PS Power and Sample Size Calculation version 2.1.30 using 80% as power of the study with the 95% confidence interval keeping the t-PA antigen as the reference variable (Kulaputana et al., 2005). The sample size calculated for each group was 7. Hence, the calculated sample size was kept 8, considering 10 % drop out.

Investigation Subjects

24 healthy sedentary males (19-34 year) who neither participated in any physical training programme nor in any regular sports were recruited for this study. The selected subjects were screened by previous medical history and blood biochemistry evaluation. The subjects were excluded if they had the chronic disease such as diabetes mellitus, cardiovascular disease, chronic migraine and orthopaedics problems that would interfere with exercise training programme. All selected subjects agreed to participate willingly in the study. This study was approved by the Research and Ethics Committee (Human), Universiti Sains Malaysia, Health Campus, Kelantan. Written informed consent was obtained during the first screening visit.

Determination of Maximal Oxygen Consumption

$\dot{V}O_2$ max of each individual was determined following a graded exercise protocol on an Excalibur Lode Cycle ergometer. The initial load was 50W and was increased at 16W for every 1 minute, till exhaustion. The pedalling frequency was kept between 60-70 rpm. The expired gas was analysed on a portable computerized metabolic measurement

Subject joins this study after signing the informed consent form approved by USM Ethical Committee (Human). Screening Health Status: Blood Pressure (BP); Electrocardiogram (ECG); Fasting blood total cholesterol; Fasting blood triallvcerides: Fastina blood alucose.

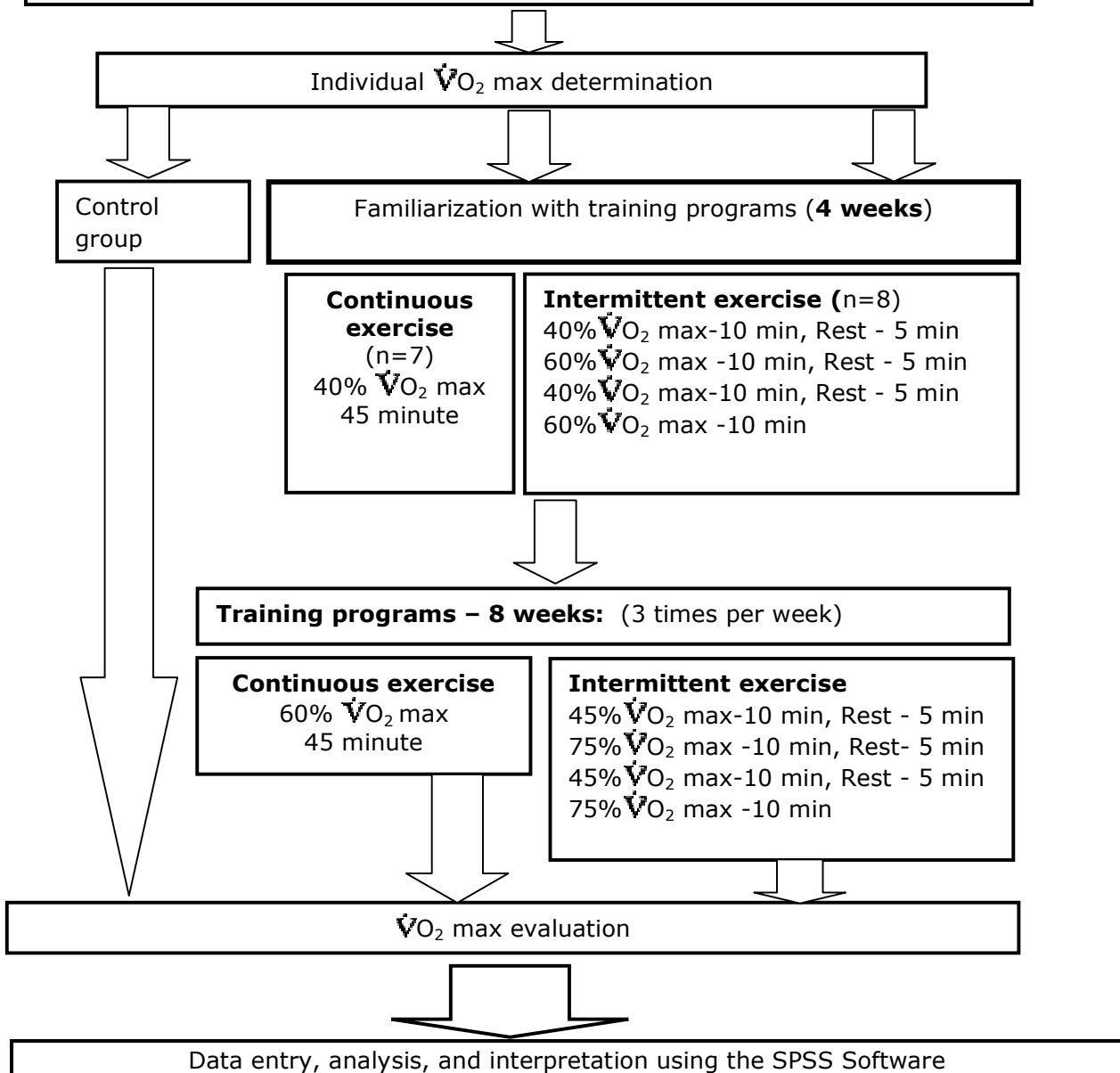


Figure 1. Flow chart of experimental protocol.

system, Metamax 3B (Cortex Biophysik, Germany). The heart rate was recorded on a Polar transmitter (T61, Polar Electro, Finland). The $\dot{V}O_2$ max was recorded following the criteria described by American College of Sports Medicine (2006).

Determination of Sub-max Workloads

The data from Metasoft programme provided the information about the workload and oxygen consumption. From this information, the graph was plotted using the Microsoft Excel Professional 2003. From the graph the equation of $Y = mx + c$ was provided. Then from equation, the training load for 40%, 45%, 60% and 75% $\dot{V}O_2$ max were estimated.

Exercise Program

The training groups participated in 12 weeks of training programme. Exercise was performed 3 times per week. The work load was continuously monitored using electronic cycle ergometer during each training session. Each training programme started by self-warm-up for two minutes and ended with self-cooling down. For continuous exercise, subjects pedalled the ergometer at 60 /min at individual workload (at 60% of individual $\dot{V}O_2$ max) for 45 minute. In intermittent exercise, the subjects cycled at 45% of individual $\dot{V}O_2$ max for 10 min followed by 5 min rest and then at 75% of individual $\dot{V}O_2$ max for 10 min followed by 5 min rest. This repetition continued until 45 min (Fig. 1).

Statistical Analysis

Statistical analysis was performed using SPSS software program version 12.00. Two-way repeated measure ANOVA were employed to determine effects of exercise training of different types of training program between and within groups, followed by paired 't' test.

Results and Discussion

Pre and post-training physical variables, including the relative $\dot{V}O_2$ max are shown in Table 1.

Table 1. Summary mean \pm SD of pre and post training anthropometric profiles and cardio-respiratory fitness in groups.

parameter		Group		
		Control (n=9)	Continuous (n=7)	Intermittent (n=8)
Weight (kg)	Pre-training	58.68 \pm 12.95	59.16 \pm 9.38	59.59 \pm 7.95
	Post training	59.58 \pm 12.71	50.00 \pm 9.52	59.71 \pm 8.35
BMI (kg/m ²)	Pre-training	20.21 \pm 3.45	19.91 \pm 3.45	21.04 \pm 2.38
	Post training	20.70 \pm 3.49	19.99 \pm 3.42	20.95 \pm 2.30
Fat mass (kg)	Pre-training	10.69 \pm 6.17	10.38 \pm 4.39	10.84 \pm 4.00
	Post training	10.60 \pm 5.76	10.26 \pm 4.76	9.56 \pm 4.12
$\dot{V}O_2$ max (ml/kg/min)	Pre-training	33.07 \pm 4.87	33.37 \pm 3.78	32.37 \pm 5.41
	Post training	33.40 \pm 5.38	39.61 \pm 6.42*	40.75 \pm 4.92*

* Significant different within group (pre and post), * $p < 0.01$

In our study, the relative $\dot{V}O_{2\max}$ of both the continuous and intermittent training groups improved significantly. Cardio respiratory endurance is defined as ability to sustain prolonged, rhythmic exercise. It is related with the highest rate of oxygen consumption obtainable by the active muscle during maximal or exhaustive exercise (Wilmore *et al*, 2008). Both the exercise training program increased the $\dot{V}O_{2\max}$ reflecting an increase in cardio-respiratory system efficiency. Previous researchers also observed that both the continuous and intermittent exercise training program were able to improve the $\dot{V}O_{2\max}$ (DeBusk *et al*, 1990; Schmidt *et al.*, 2001; Hardman, 2001; Murphy *et al*, 2002). We observed that the degree of improvement in $\dot{V}O_{2\max}$ was higher in intermittent group than their continuous training group counterparts. This might be due to the fact that during high intensity exercise in intermittent training, the heart rate was much higher than those of the continuous group. In intermittent group the heart varied from 170 – 120, as compared to 140-150 in the continuous group individuals. In our study we tried to keep both the intermittent and continuous type training iso-intense. Significant improvement in cardio respiratory fitness in continuous group and intermittent group ($p < 0.01$) may be due to enhancement of aerobic capacity and high total energy expenditure of training which might have been caused by high intensity movement (Hardman, 2001). Murphy *et al.* (2002) found that short bout exercise showed greater increase in the $\dot{V}O_{2\max}$ compared to long session. We found that both continuous and intermittent groups increase the $\dot{V}O_{2\max}$. This finding is supported by other studies which reported that both continuous and intermittent exercise training programs improve cardio respiratory fitness (DeBusk *et al.*, 1990; Hardman, 2001; Schmidt *et al.*, 2001). No significant interaction was found in body weight, body fat percent and BMI of the sedentary persons.

It is concluded that an iso-intense continuous and intermittent training programme of 12 weeks duration can improve the $\dot{V}O_{2\max}$ significantly in sedentary individual. Type of training depends on individual choice.

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