
THE EFFECTIVENESS OF HIGH INTENSITY INTERVAL TRAINING WITH BLOOD FLOW RESTRICTION TRAINING ON ANAEROBIC THRESHOLD IN RUNNERS

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ABSTRACT

The overall performance of runners is associated with the anaerobic threshold level. Anaerobic threshold plays an critical function in runner's endurance. Anaerobic threshold value is likewise closely related to the level of runner's fatigue when doing physical exercise or when competing for a long time. If the body's endurance level cannot face up to the activities carried out, it will give a negative effect on their performance. There are exercises that intention to growth the anaerobic threshold value, particularly high intensity interval training and blood flow restriction training. High intensity interval training can increase the anaerobic value through the mechanism of provide a high stimulus to anaerobic glycolytic and carbonic anhydrase reaction with formation (H^+) that improved buffering capacity. Addition of blood flood restriction training by using limb occlusion pressure causes local hypoxia, so it will increase muscle metabolic demand. It will induce metabolic acidosis with improved hydrogen ions and lactate production.

Key Words: *High Intesity Interval Training; Blood Flow Restriction; Anaerobic Threshold; Anaerobic Capacity; Runners*

INTRODUCTION

Anaerobic threshold is one of the components that performs an critical function in endurance while doing aggressive sports activities. Anaerobic threshold is the level of oxygen fed on in the presence of an increase in the concentration of lactate in the blood¹. Among the most aggressive sports activities that calls for the role of the anaerobic threshold is running. The overall performance of athlete can be prognosticated by way of understanding the anaerobic threshold level of the athlete. There are precise exercise that can be implemented to growth the anaerobic threshold wherein the body can adapat to the buildup of lactate inside the blood so that athletes do not revel in fast fatigue, ensuing within the achievement of performance enhancements in athletes². Going for running is a sport that is quite famous in numerous walks of existence. Whilst doing running sport competition for a long term and tandem with an increasing pace, the body's program will use the anaerobic mechanism to keep body homeostasis.

Anaerobic system serve as a supply of energy in muscle group when contracting for a long time with the aid of forming ATP through the glycolysis process³. Inside the procedure, the ATP produced much less compared to the aerobic system, ensuing in an enlarge in the producing of lactic acid and metabolic acidosis. The point factor of the transition is said to be the anaerobic threshold⁴. The value of anaerobic threshold is intently related to the extent of fatigue in athletes when appearing physical and technical training over an extended time period and accompanied through an growth in the exertion given. If the staying power of the body isn't always able to face up the given exercises, fatigue will arise which can have a bad

impact on athletes performance⁵. Physical performance in competitive sport activities athletes relies upon on the body's included physiological mechanism, which is the body's ability to provide physiological response to fulfill the demanding situations offered. The optimum consequences to be finished are obtained from the improvement of the response thru training⁶.

The effects of fatigue can be reduced by increasing endurance through anaerobic threshold⁷. There are several exercises that serve to increase the value of the anaerobic threshold. The exercises that can be given are high intensity interval training and blood flow restriction training. High intensity interval training is a repetitive exercise with high intensity but interspersed with a recovery period. A few literature states that high intensity interval training has been proven to improve aerobic and anaerobic performance in quick length of time⁸. Meanwhile, blood flow restriction training is an exercise that works by reducing arterial blood flow in the muscles that work while also blocking off the flow returned of the veins⁹. Based on this background, this study aims to examine more deeply the effectiveness of high intensity interval training with blood flow restriction training on the anaerobic threshold in runners.

METHODS

The method in this study use a literature review or study literature articles which using secondary statistics studies end result from several numerous studies related to the effectiveness of high intensity interval training and blood flow restriction training on anaerobic threshold in runners. The literatures were had been thru electronic database such as Pubmed, Pedro, and Google Scholar. They were had been discussed approximately high intensity interval training, blood flow restriction and runners, high intensity interval training and blood flow restriction affects anaerobic threshold, and high intensity interval training and blood flow restriction affects anaerobic capacity. The studies were included in this study if they are: 1. in English, 2. mentioned the correlation runners and anaerobic threshold, 3. reported about high intensity and blood flow restriction for anaerobic threshold, 4. study clinical trial, experimelntal study, systemic review and metaanalysis, review article and randomized controlled trial. The studies have been excluded from this study if they are not mentioned about the exercise for anaerobic threshold and endurance performance.

RESULT AND DISCUSSION

High Intensity Interval Training (HIIT) has been demonstrating good effect which is increasing aerobic and anaerobic capacity. Those can improved training time efficiency¹⁰. HIIT is one of the best exercise as well advised for improving endurance performance and the physical performance of athletes. This effect can be achieved through anaerobic threshold. Commonly, HIIT formed with repetitive short to long session of high intensity exercise. The session consist of aerobic exercises with 100% oxygen consumption (VO_2max), periods of rest, and low or moderate intensity exercise¹¹.

Studies conducted with the aid of Herrod et al in 2020 aims to appraise the impact of either shorthening or lengthening high intensity interval training on cardiorespiratory fitness adjusments. This adjusments via anaerobic threshold become measure in a single experimental study showed that after two weeks, HIIT seems to be inadequate to improve anaerobic threshold, however this end result achievable with 4 or 6 weeks training. The study concluded that time route of cardiorespiratory transformations to a single, protocol of HIIT that 5 via 1 minute completed 3 times/week can bring out widespread significant tolerance of exercise, despite the fact that vast enhancements in cardiorespiratory fitness can guide by doing this training for 4 weeks¹².

Research by Belfry et al in 2020 showed that to be able to refine ventilatory threshold and VO_2 peak by giving repeated high intensity with 10s work/5s recovery intermittent cycles for 30 minutes and carried out as 12 sessions. It shows this training led to the contribution a huge of anaerobic glycolytic phosphorylation or ventilatory buffering. Results in intermittent training effective to stimulate anaerobic and aerobic that will be improved performances and post intermittent training on the 60s test result showed that there is an increase VCO_2 . Training with excessive intensity also has related responses to enlarge carbonic anhydrase activity¹³. This training provide a high stimulate to anaerobic glycolytic and carbonic anhydrase reaction with formation (H^+) that improved buffering capacity¹⁴.

Research by Batra et al (2017) resulted by 8 week interval training will be enhance anaerobic performance via glycolytic energy system and adaptations phosphagen system. The adaptation is obtained through the phosphocreatine (PCr) energy pathway which causes changes in the increase adenosine triphosphate (ATP) which will eventually improving peak power (P_{max}). This way are important for runners to keep their performance during exercise and competition¹⁵. HIIT frequently from anaerobic metabolism, that energy assist the training with distinctive proportions and specific time intervals. Anaerobic glycolysis give a supply of ATP to maintaining required power output capacity¹⁶. A research was conducted showed 10 second high intensity work and 20 seconds of rest periods will keep anaerobic glycolysis contribution to metabolic pattern¹⁷.

Training program in anaerobic threshold level is suitable for endurance athletes. It can be resulting a change in muscle ultrastructure, oxidative capacity, capillarization, and substrate utilization¹⁸. These changes will have an impact on physiological diversifications together with lower O_2 for air flow, lactate accumulation, and the usage of glycogen for power output. Anaerobic threshold level will be upgrade if training which given at 80% VO_2max for nine weeks or a bit over anaerobic threshold level¹⁹. They are increase lactate removal inside the blood by increasing monocarboxylate transporter, reduce the need for carbohydrate metabolism and reduce lactate formation by increasing the oxidation of enzyme, reduce lactate formation by lowering ratio and concentration of phosphofruktokinase-1 with citrate synthases and increase percentage of pyruvate to the krebs cycle which reduce lactate formation through the LDH reaction by enzyme concentration and mitochondrial density in skeletal muscle²⁰. This training can increase nicotinamide adenine dinucleotide by reducing NADH form shuttle enzyme levels. This enzymatic system take part with LA dehydrogenase for NADH²¹.

Another research conducted by Monks et al (2017) the effect of HITT on anaerobic threshold significantly higher in the high intensity interval training group than high intensity continuous training group. This thing coming up because development of intermediate and fast twitch muscle during the interval training²². Research was done by Abe et al (2015) showed that HIIT will also improve the protein levels of Hif-1 α attend by increase gene expression of glycolytic and glycogenesis enzymes. This protein can be used as regulators in the body's adaptation of anaerobic metabolism to HIIT²³.

High intensity interval training (HIIT) can be combined with blood flow restriction training to attain anaerobic threshold. Blood flow restriction (BFR) training is training that uses a compressive cuff wrapped on the limb which leads to a lowering arterial flow and the return of venous²⁴. Addition of blood flow restriction (BFR) training to HIIT has been proven increasing anaerobic capacity²⁵. Jessee et al (2018) found that impact of BFR training significantly growing endurance muscle from pre to post training²⁶. BFR training influence the activation of type II muscle fiber and upregulates growth hormone which is for protein synthesis²⁷. Research by Franz et al in 2020 showed that the provision using 50% of arterial

limb occlusion pressure (LOP) can set off cardiovascular response inclusive of heart rate (HR) and intravascular pressure considerably expanded during the training. BFR training also induce metabolic acidosis with increasing the hydrogen ion and lactate production. Elevated the hydrogen ion cause the occurrence of inhibition displacement and reuptake of concentration potassium²⁸.

The systemic review studies carried out by Silva et al in 2019 confirmed that addition BFR training to exercise offer an acute and chronic metabolic variable and neuromuscular changes. At some stage in BFR training, metabolic adjustments arises with an growth in EPOC, VO₂, heart rate, and lactate production. In training, it stimulates group III dan IV afferent pathways, resulting in inhibition of alpha motorneuron in order that metabolic accumulation is completed. To prevent conduction failure, that is accomplished via developing muscle activity and recruitment of muscle fibers. There are neural adaptations and myogenic elements that increase in muscle hypertrophy is caused by an upgrade the level of phosphorylation and protein synthesis²⁹.

Research by Nitzsche et al (2018) showed that outcomes exercise with BFR training growing lactate concentration throughout and after training due to reduced the supply of arterial oxygen to the muscle than without blood flow restriction³⁰. Local hypoxia ensuing modified in cardiorespiratory response, accelerated metabolic demands of muscle and multiplied in energy expenditure³¹. When high intensity interval training combined with blood flow restriction training, it will likely be reducing in the availability of the substrate inside the blood so the local substrate will atone for the unavailability which includes glycogen and phosphocreatine for ATP production³². Hypoxia due to BFR training is associated with an increase in anaerobic metabolism and it is necessary to monitor VO₂ at the end of the training session³³.

CONCLUSION

An offers of high intensity interval training combined with blood flow restriction training can assist to enhance the anaerobic threshold level in runners. HIIT can increase the anaerobic threshold through a mechanism to stimulate carbonic anhydrase reaction with formation (H⁺) and anaerobic glycolytic, contributed of glycolytic energy system and adaptations phosphagen system. Addition of BFR training while the usage of a compressive cuff wrapped on the limb which leads to a reduction of arterial flow and venous return will reduce the deliver of arterial oxygen to the muscles and it is demanding anaerobic glycolysis or lactate production. BFR also can increase recruitment of muscle fibers resulting of metabolic accumulation.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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