THE EFFECTS OF TWO RELAXATION TECHNIQUES ON PSYCHOMOTOR, PSYCHOLOGICAL AND PHYSIOLOGICAL VARIABLES FOLLOWING REPEATED SUB-MAXIMAL INTENSITY EXERCISE AMONG SCHOOL ATHLETES

BY

HAZWANI AHMAD YUSOF @ HANAFI

Research Project Report Submitted for the Degree of Master of Science (Sports Science) for the Course Code GST 508

UNIVERSITI SAINS MALAYSIA
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LIST OF TERMS

ANOVA	Analysis of Variances
AGR	Autogenic Relaxation
BPM	$beats.min^{-1}$
cm	centimetre
CRT	Choice Reaction Time
HR_{max}	Maximum Heart Rate
kg	kilogram
ml	millilitre
min	minute
ms	millisecond
PMR	Progressive Muscle Relaxation
RER	Respiratory Exchange Ratio
RPE	Rating of Perceived Exertion
rpm	revolutions per minute
SD	Standard Deviation
SPSS	Statistical Package for Social Sciences
VO_2	Oxygen Consumption
VO_{2max}	Maximal Oxygen Consumption
W	watt

Kesan daripada Dua Teknik Istirahat ke atas Angkubah Psikomotor, Psikologi dan Fisiologi selepas Senaman Berintensiti Sub-Maksimum Secara Berulang-ulang di Kalangan Atlet Sekolah.

Abstrak

Kajian ini bertujuan untuk mengkaji kesan daripada dua teknik istirahat ke atas angkubah psikomotor (masa tindak balas pilihan), psikologi (tanggapan tahap usaha (RPE) dan fisiologi (kadar denyutan jantung, pengambilan oksigen (VO_2)) selepas senaman berintensiti sub-maksimum secara berulang-ulang. Dua puluh empat orang remaja lelaki aktif dengan purata umur 14.1 ± 1.3 tahun, tinggi 157.3 ± 6.1 cm, berat 45.6 ± 7.2 kg, VO_{2max} 45.7 ± 4.2 $ml.kg^{-1}.min^{-1}$ dan HR_{max} 205.9 ± 1.3 telah mengambil bahagian dalam ujikaji ini. Mereka dibahagikan secara rawak kepada salah satu daripada tiga kumpulan: 'Autogenic relaxation (AGR)', 'progressive muscle relaxation (PMR)' dan kumpulan kawalan. Kumpulan AGR dan PMR diarahkan menjalani dua sesi eksperimen; sebelum dan selepas latihan istirahat. Bagaimanapun, kumpulan kawalan menjalani prosedur eksperimen yang sama kecuali latihan istirahat. Setiap sesi eksperimen mengandungi empat ujian di mana mereka perlu berbasikal pada 60% VO_{2max} selama 10 minit diikuti dengan 90% VO_{2max} selama 2 minit. Kemudian, ini diikuti dengan 3 minit selang rehat di mana ujian masa tindak balas pilihan dijalankan. Tambahan pula, RPE, kadar denyutan jantung dan VO_2 direkod pada penghujung setiap ujian. Keputusan ujian 'two-way repeated measure ANOVA' menunjukkan tiada interaksi signifikan ($p > .05$) antara kumpulan melintasi ujian eksperimen untuk semua parameter. Bagaimanapun, keputusan kesan utama menunjukkan perbezaan yang signifikan ($p < .05$) untuk sesi eksperimen untuk RPE dan VO_2. 'Pairwise

comparison' analisis menunjukkan pengurangan yang signifikan ($p < .05$) dalam nilai RPE dari sesi pre- ke post-rawatan untuk kumpulan PMR dan pengurangan yang signifikan ($p < .05$) dalam nilai VO_2 dari sesi pre- ke post-rawatan untuk kumpulan AGR dan kawalan. Oleh itu, kajian ini merumuskan bahawa kedua- dua teknik istirahat tidak berbeza pada masa tindak balas pilihan, RPE, VO_2 dan kadar denyutan jantung selepas senaman berintensiti sub-maksimum secara berulang-ulang. Bagaimanapun, bila dianalisis secara berasingan, PMR didapati mengurangkan RPE manakala AGR merendahkan VO_2.

The Effects of Two Relaxation Techniques on Psychomotor, Psychological and Physiological Variables following Repeated Sub-Maximal Intensity Exercise among School Athletes

Abstract

The present study was undertaken with an objective to investigate the effects of two relaxation techniques on selected psychomotor (choice reaction time), psychological (rating of perceived exertion (RPE) and physiological (heart rate, oxygen consumption (VO_2)) variables following repeated sub-maximal intensity exercise. Twenty four physically active young males with the mean age of 14.1 ± 1.3 years, height 157.3 ± 6.1 cm, weight 45.6 ± 7.2 kg, VO_{2max} 45.7 ± 4.2 $ml.kg^{-1}.min^{-1}$ and HR_{max} 205.9 ± 1.3 participated in this study. They were randomly divided into one of the three groups: Autogenic relaxation (AGR), progressive muscle relaxation (PMR) and a control group. AGR and PMR group were tested in two experimental sessions; prior to and after relaxation training. However, the control group performed the same experimental procedures except the relaxation training. Each experimental session consists of four trials, where they had to cycle at 60% VO_{2max} for 10 minutes followed by 90% VO_{2max} for 2 minutes in each trial. Then, it is followed by 3-minute resting interval where choice reaction time (CRT) was tested. Furthermore, RPE, heart rate, and VO_2 were recorded at the end of each trial. The results of two-way repeated measure ANOVA revealed a non significant ($p > .05$) interaction between the groups across the experimental trials in all of the selected parameters. However, results of the main effect revealed a significant ($p < .05$) difference for experimental sessions for RPE and VO_2. Pair wise comparison analysis revealed a significant ($p < .05$) reduction in RPE value from pre-

to post-intervention sessions for PMR group and a significant ($p < .05$) decrease in the value of VO_2 from pre- to post-intervention exercise for AGR and control groups. Thus, this study concluded that both relaxation techniques did not differ in terms of choice reaction time, RPE, VO_2 and heart rate following repeated sub-maximal intensity exercise. However, when analysed separately, PMR appears to reduce RPE while AGR appears to reduce VO_2.

CHAPTER I

INTRODUCTION

1.1 Background and scope of the study

Prolonged exposure to intermittent high intensity exercises is common among athletes in certain sports. A number of studies have shown that athletes' information processing capability gradually deteriorates following high intensity exercise (Brisswalter *et al.*, 1995; Cox, 2002). The ability to maintain optimal cognitive-motor functioning during high intensity exercise is important, partly because athletes' cognitive-motor contribute to their ability to make fast starts in track or swimming or to dodge a fast attack in fencing or karate or in critical situations where they have to make an instant decision (Cox, 2002). It has been shown that during high intensity exercise, cognitive performance decreases in trained middle-distance runners as well as among untrained individuals. Decline in these cognitive functioning may be due to fatigue (Brisswalter *et al.*, 1995). Thus, the ability to maintain these cognitive-motor functions during exercise-induced fatigue may potentially enhance athletes' performance.

Relaxation training has been shown to benefit athletes by increasing attention, reducing anxiety, reducing the heart rate responses, lowering blood pressure, reducing the breathing frequency, muscle tension and improving concentration (Eason *et al.*, 1986). A number of relaxation strategies are available and can be reviewed in the literature for the betterment of athletic performance. These strategies are categorized as mental relaxation

and physical relaxation, in the form of autogenic relaxation (AGR) and progressive muscle relaxation (PMR) respectively.

Among the various techniques aimed at the regulation of mental states, autogenic relaxation training seems to be particularly effective in influencing subjects' physiological states and enhancing performance (Blumenstein *et al.*, 1995). AGR technique, developed by Johannes Schultz and Wolfgang Luthe (cited in Benson, 1976) refers to the technique that relaxes the mind to relax the body. "Autogenic" means self-regulation. AGR technique is a self-hypnotic method which uses both visual imagery and body awareness to move a person into a deep state of relaxation. The person imagines a peaceful place and then focuses on different physical sensations, moving from the feet to the head. Autogenic relaxation technique use the six "standard exercises", like, self-suggestion of heaviness and warmth on the limbs, a regular and rhythmic heart beat, coolness in the forehead, warmth in the solar plexus, and autonomic breathing.

PMR technique, developed by Edmund Jacobson consists of tensing and relaxing individual muscles sequentially (Benson, 1976). This method helps individuals to develop body awareness and educates them on how to release tension. When the individuals do progressive muscle relaxation, they have to start from the top of the body and progress to the bottom, or vice versa. Progressing sequentially gives the individuals an easy-to-follow sense of order.

Although the effects of exercise on psychomotor, psychological and physiological variables have been investigated, evidence of positive effects of relaxation exercise on

psychomotor, psychological and physiological variables following repeated sub-maximal intensity of exercise is lacking. Thus, this study is designed to fill this gap in the literature. Specifically, the present study sought to investigate the effects of two relaxation techniques, AGR and PMR on selected psychomotor, psychological and physiological variables following sub-maximal intermittent exercise. Furthermore, this study also aimed to compare the efficacy of these two relaxation techniques on the basis of the selected parameters.

1.2 Operational definitions

In the present study, the following terminologies are operationalised as follows:

1.2.1 Relaxation

The act of relaxing or the state of being relaxed which cause refreshment of body or mind and loosening of tense muscle or muscle fibres.

1.2.2 Psychomotor

Movement or muscular activity associated with mental processes.

1.2.3 Repeated sub-maximal intensity exercise

Repeated cycling that is equal to or greater than 70% HR_{max} and also equal to or greater than 90% VO_{2max}.

1.2.4 Choice reaction time

The time required to respond to each presented visual stimulus.

1.2.5 Rating of perceived exertion

The degree of heaviness and strain experienced in physical work as estimated based on the score of Borg's (1998) rating of perceived exertion.

1.3 Objectives of the study

The present study was undertaken with the aims to:

1. investigate the specific effects of two different relaxation techniques on selected psychomotor, psychological and physiological variables following repeated sub-maximal intensity exercise.
2. compare the effectiveness of these two relaxation techniques on the basis of the selected psychomotor, psychological and physiological variables following repeated sub-maximal intensity exercise.

1.4 Hypothesis

1. H_O: There are no significant effects of AGR and PMR techniques on choice reaction time, rating of perceived exertion, heart rate and oxygen consumption.
2. H_A: There are significant effects of AGR and PMR techniques on choice reaction time, rating of perceived exertion, heart rate and oxygen consumption.
3. H_O: There are no significant differences between AGR and PMR on choice reaction time, rating of perceived exertion, heart rate and oxygen consumption.
4. H_A: There are significant differences between AGR and PMR on choice reaction time, rating of perceived exertion, heart rate and oxygen consumption.

1.5 Significance of the study

Generally, the effects of relaxation responses on psychological variables during exercise have been extensively investigated. However, the studies on the effects of relaxation techniques on other variables such as psychomotor and physiological variables are scanty in the literature. Thus, this study will provide evidence on benefits of relaxation techniques on psychomotor, psychological and physiological variables following repeated sub-maximal intensity exercise among school athletes.

The results are also expected to provide evidence of a superior relaxation technique that can help athletes in delaying the onset of fatigue and maintaining an optimal performance in fatigued state. The results can potentially be useful in designing a relaxation programme for school athletes to improve their performance.

Moreover, most of the previous studies have focused on university athletes, but researches on the impact of mental training on school athletes have seldom been investigated. So, the output of this study can be used as a guideline to implement the relaxation training programme techniques among school athletes, especially in Malaysia as well as in others part of the world.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Sport psychology is a science in which the principles of psychology are applied in a sport or exercise settings in order to promote positive sporting performances (Cox, 2002). Sport psychology is considered to be a recognised science and its research and knowledge base are growing gradually. Currently, a growing number of research findings have been supporting the positive effects of psychological intervention such as intervention of relaxation techniques to boost up sports performance (Murphy, 1995). In this chapter, studies related to the effects of relaxation training on psychomotor, psychological and physiological performance have been reviewed.

2.2 Relaxation training

Nowadays, coaches and athletes realise that strength, speed, coordination and other motor abilities in themselves may not be enough for peak performance. Instead mental aspects of sport are also crucial in determining success and failure. Accordingly, numerous interventions and techniques intended to enhance the performance of athlete during competition have been proposed (Martin *et al.*, 2005). Existing evidence supporting positive influence of psychological methods on athletic performance is impressive (Cox, 2002). Indeed successful athletes are reported to have used some form of psychological

methods to prepare themselves for competition. To cite an example, Greg Louganis, the gold medallist in both the springboard and platform diving events at the 1984 and 1988 summer Olympics, was reported to have used imagery to prepare himself for each dive (Onestak, 1991). Other famous athletes who have admitted using psychological methods in their performance routine include Pete Maravich, high jumper Dick Fosbury, triple gold-medallist skier Jedn- Claude Killy, O.J. Simpson, Chris Evert and Jack Nicklaus (Onestak, 1991). The most commonly utilised psychological methods among athletes are visual imagery, relaxation, positive self-talk and modelling / video observation. However, psychological techniques that are most beneficial to sports still remain inconclusive.

Relaxation training is a behavioural technique that can be applied to a variety of problems such as anxiety and anger management (Friedberg and McClure, 2002). An important model in explaining the effects of relaxation training is the multi-process theory proposed by Davidson and Schwartz in 1976. Davidson and Schwartz suggest three effects of relaxation: somatic, cognitive and attention. The somatic response to relaxation training refers to the effects of relaxation on physiological parameters (e.g., respiration, heart rate) while the cognitive effects pertain to mental activities. On the other hand, the attention component relates to a continuum represented by active, self-regulating behaviour at one end (e.g., controlling your breathing), and at the other end, a passive awareness of a pre-existing behaviour without any overt attempt to modify it (e.g., observing your breathing). The multi-process theory incorporates a "specific-effects" hypothesis. Specifically, this theory suggests that relaxation techniques have different effects depending on the relative cognitive and somatic components involved in each technique.

Relaxation technique can be generally categorised into mental relaxation and physical relaxation (Cox, 2002). An example of mental relaxation is autogenic relaxation (AGR), while progressive muscle relaxation (PMR) exemplifies physical relaxation. Each method evoke the same physiological responses, such as, a decrease in oxygen consumption, blood pressure, heart rate, breathing frequency, skeletal muscle activity, an increase in skin resistance and alpha waves (Benson, 1976).

AGR, developed by Schultz and Luthe in 1959, refers to the technique that relaxes the mind to relax the body. "Autogenic" means self-regulation or self-generation (Benson, 1976). Thus, it is a self-hypnotic method and uses both the visual imagery and body awareness to move a person into a deep state of relaxation. The person imagines a peaceful place and then focuses on different physical sensations, moving from the feet to the head. Autogenic relaxation technique composes of six "standard exercises". These standard exercises are self-suggestion of heaviness and warmth in the limbs, calm and regular heart beat, coolness in the forehead, warmth in the solar plexus, and automatic breathing. This technique needs to be practised several times until the person is able to shift voluntarily to a less stressful state (Benson, 1976).

PMR, developed by Dr. Edmund Jacobson in 1975, emphasises the relaxation of voluntary skeletal muscle (Benson, 1976). Contrary to autogenic relaxation, Jacobson, one of the pioneers of psychological relaxations, asserted that relaxation of muscles would lead to relaxation of the mind, "because an emotional state fails to exist in the presence of complete relaxation of the peripheral parts involved" (Dimon, 1999). Relaxation inhibits the generation of thoughts and emotions, and undoes the effects of neuromuscular

hypertension on the body. PMR consists of sequential tensing and relaxing of individual muscles. This method helps individuals to develop body awareness and educates them on how to release the tension. When individuals engage in PMR, they may start from the top of the body and progress to the bottom, or vice versa. Proceeding sequentially gives the individuals an easy-to-follow sense of order. Most athletes can achieve relaxation after training a few muscle groups (Benson, 1976). The benefits of PMR have been observed in numerous settings. For instance, several studies have demonstrated the effects progressive muscle relaxation in reducing osteoarthritis pain (Gay *et al.*, 2002), chronic headache (Blanchard *et al.*, 1982) and cancer-related pain (Tatrow and Montgomery, 2006). The analgesic effect of PMR is the result of decreased afferent neural impulses from the skeletal musculature contributing to a reduction in sympathetic activity associated with the experience of pain (Benson, 1976). PMR also relieves tension in accessory muscles that may contribute to the experience of pain (Benson, 1976).

2.3 Relaxation training and sport performance

The first significant study examining the relationship between relaxation training and athletic performance has been studied by Vandell *et al.* (1943). The researchers divided 12 senior high school students into one of the following three conditions over a 20-day period; (1) physical practice on day one (2) physical practice throughout the duration of the experiment, and (3) physical practice throughout the duration of the experiment with 15 minutes of mental training. Mental training participants were required to imagine themselves doing the motor task. They found that positive improvements were obtained by the subjects who received physical practice in combination with the mental training.

Parallel findings were obtained by Noel (1980). In this study, the researchers investigated the effect of relaxation training followed by visuo-motor behavioural rehearsal on tennis service performance during a tournament involving 14 male tennis players aged 17-45 years. It was found that players who trained in relaxation training and visualisation showed significant improvement in their percentage of good first serves when compared to players who did not receive any relaxation training.

In another study, Rogerson and Hrycaiko (2002) examined the effectiveness of relaxation technique and self talk on the performance of ice hockey goaltenders during league games. After every game, the goalies completed an assessment form in which they indicated whether they used both techniques during the period of the games. The result showed that both methods are effective in producing improvements in the save percentage made by the goalies.

Furthermore, according to recent study by Ortiz (2006), PMR was also effective in improving performance in a group of female recreational golfers. The study was conducted over a 3-month period during which the experimental group (n = 9) regularly engaged in PMR. Performance were measured based on their scores, putts per round and number of greens hit in regulation prior to and after the intervention. The results indicated a significant improvement in the experimental group when compared to the control group.

In general, most studies suggested positive influence of relaxation training on athletic performances. Although majority of the studies showed that increased performance was associated with a combination with some other cognitive technique (Greenspan and