

**COMPARISON OF THE EFFECTS OF TWO TYPES OF
PROGRESSIVE MUSCLE RELAXATION (7 AND 16 MUSCLE
GROUPS) ON SELECTED PSYCHOPHYSIOLOGICAL AND
PSYCHOMOTOR PARAMETERS FOLLOWING REPEATED SUB-
MAXIMAL INTENSITY EXERCISE IN YOUNG ATHLETES**

BY

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LIST OF ABBREVIATIONS

ANOVA	Analysis of Variance
BMI	Body Mass Index
bpm	beats per minute
CRT	Choice Reaction Time
EMG	Electromyography
GSR	Galvanic Skin Response
GT	Grid test
HR _{max}	Maximum heart rate
ms	milisecond
mV	milivolt
PMR	Progressive Muscle Relaxation
RPE	Rating of Perceived Exertion
Sc	Skin conductance
ScAL	Tonic skin conductance adaptation level
SD	Standard Deviation
SF	Spontaneous fluctuation
SPSS	Statistical Package for Social Sciences
Ss	Stabilization score
Ts	Time to stabilization
VO _{2max}	Maximal oxygen consumption

Perbandingan Kesan Dua Jenis Teknik Relaksasi Otot Berperingkat (7 dan 16 Kumpulan Otot) Ke Atas Parameter Psikofisiologi dan Psikomotor Terpilih Selepas Latihan Berintensiti Sederhana Tinggi di Kalangan Atlit Muda

ABSTRAK

Kajian ini bertujuan untuk membandingkan kesan dua jenis teknik relaksasi otot berperingkat (7 dan 16 kumpulan otot) ke atas parameter psikofisiologi dan psikomotor terpilih selepas latihan berintensiti sederhana tinggi. Dua puluh enam orang remaja lelaki aktif dengan purata umur 13.4 ± 0.5 tahun, berat 50.8 ± 8.1 kg, BMI 19.2 ± 1.7 kg.m², VO_{2max} 54.48 ± 6.67 ml.kg⁻¹.min⁻¹ and HR_{max} 201.7 ± 1.5 bpm telah mengambil bahagian dalam ujikaji ini. Mereka dibahagikan secara rawak kepada kumpulan kawalan ($n = 8$) dan dua kumpulan intervensi: 'Progressive Muscle Relaxation (PMR)' 16 kumpulan otot ($n = 9$) dan 'Progressive Muscle Relaxation (PMR)' 7 kumpulan otot ($n = 9$). Setiap peserta dinilai dalam tiga sesi ujian; permulaan intervensi, pertengahan intervensi (selepas 6 sesi latihan relaksasi) dan akhir intervensi (selepas 12 sesi latihan relaksasi). Dalam setiap ujian intervensi, aktiviti elektrik otot (EMG) dan tindak balas kulit galvani (GSR) diukur. Untuk parameter seperti penggunaan oksigen (VO_2), kadar denyutan jantung, RPE, ujian masa tindak balas pilihan dan tumpuan, penilaian hanya dilakukan pada ujian eksperimental 1 dan ujian eksperimental 3. Sesi eksperimental 1 dan 3 mengandungi 4 ujian di mana peserta perlu berlari pada 60% VO_{2max} selama 10 minit diikuti 90% VO_{2max} selama 2 minit. VO_2 , kadar denyutan jantung dan RPE direkod pada penghujung setiap ujian. Kemudian, ia diikuti dengan 3 minit sela rehat di mana masa tindak balas pilihan dan tumpuan (ujian grid) di ukur.

Peserta dari kumpulan intervensi menghadiri program latihan relaksasi selama 3 sesi seminggu untuk 4 minggu. Keputusan ujian 'two-way repeated measure ANOVA' menunjukkan terdapat interaksi signifikan ($p < 0.05$) antara kumpulan merentasi sesi eksperimen bagi kadar denyutan jantung, GSR purata aliran kulit tonik (Sc), masa tindak balas pilihan dan ujian tumpuan grid. Ujian perbandingan berpasangan menunjukkan kemajuan yang signifikan dalam kadar denyutan jantung dan ujian tumpuan grid bagi kedua-dua kumpulan intervensi berbanding kumpulan kawalan. Selepas 12 sesi latihan PMR, kumpulan PMR 16 kumpulan otot menunjukkan kemajuan yang signifikan dalam GSR purata aliran kulit tonik (Sc) dan masa tindak balas pilihan berbanding kumpulan kawalan. Walau bagaimanapun, keputusan menunjukkan tiada interaksi signifikan ($p > 0.05$) antara kumpulan merentasi sesi eksperimen dalam parameter-parameter lain. Keputusan kajian yang dilaporkan sebelum ini memberi fokus pada kesan jangka masa panjang, kesan serta-merta latihan PMR pula menunjukkan bahawa kumpulan PMR 16 kumpulan otot mempunyai nilai SFs yang lebih rendah berbanding kumpulan kawalan. Selain itu, kedua-dua kumpulan intervensi menunjukkan peningkatan dalam nilai $ScAL$ berbanding kumpulan kawalan. Keputusan juga menunjukkan bahawa kumpulan kawalan mencatat Ts lebih lama dari ujian permulaan dan akhir. Walau bagaimanapun, tidak terdapat interaksi yang signifikan dalam Ss , Sc dan 'coping'. Sebagai kesimpulan, 12 sesi latihan PMR 16 kumpulan otot membawa kepada kemajuan yang signifikan dalam kadar denyutan jantung, GSR purata aliran kulit tonik (Sc), masa tindak balas pilihan dan kebolehan tumpuan. Selain itu, ia juga mempunyai kesan serta-merta yang lebih baik.

Comparison of the Effects of Two Types of Progressive Muscle Relaxation (7 and 16 muscle groups) on Selected Psychophysiological Parameters and Psychomotor Parameters Following Repeated Sub-Maximal Intensity Exercise in Young Athletes.

ABSTRACT

The present study was undertaken with an objective to compare the effectiveness of two types of Progressive Muscle Relaxation (PMR) (7 and 16 muscle groups) on selected psychophysiological and psychomotor parameters following repeated sub-maximal intensity exercise. Twenty six physically active young males with the mean age 13.4 ± 0.5 years old, weight 50.8 ± 8.1 kg, BMI 19.2 ± 1.7 kg.m⁻², VO_{2max} 54.48 ± 6.67 ml.kg⁻¹.min⁻¹ and HR_{max} 201.7 ± 1.5 beats.min⁻¹ participated in this study. They were randomly assigned to the control group (n = 8) and two intervention groups: 16 muscle groups Progressive Muscle Relaxation (n = 9) and 7 muscle groups Progressive Muscle Relaxation (n = 9). Each participant was tested in three experimental sessions; pre-intervention, mid-intervention (after 6 sessions of relaxation training) and post-intervention (after 12 sessions of relaxation training). In every experimental evaluation, muscle electrical activity (EMG) and Galvanic Skin Response (GSR) were measured. For parameters such as oxygen consumption (VO_2), heart rate, rating of perceived exertion (RPE), choice reaction time, and concentration, the measurements were conducted only on experimental evaluation 1 and experimental evaluation 3. Experimental evaluations 1 and 3 consist of four trials, where subjects had to run at 60% VO_{2max} for 10 minutes followed by 90% VO_{2max} for 2 minutes in each trial. VO_2 , heart rate and

RPE were recorded at the end of each trial. Then, it was followed by 3 minutes resting interval where choice reaction time and concentration (grid test) were measured. Participants from the intervention groups attended the relaxation training program for 3 sessions per week for 4 weeks. The results of two-way repeated measure ANOVA revealed a significant ($p < 0.05$) interaction between groups across the experimental sessions in heart rate, GSR mean of tonic skin conductance (Sc), choice reaction time, and concentration grid test. Pair wise comparison analysis revealed a significant improvement in heart rate and concentration grid test for both intervention groups compare to control group. After 12 sessions of PMR training, 16 muscle groups PMR subjects showed a significant improvement in GSR mean of tonic skin conductance (Sc) and choice reaction time compare to control group. However, the results revealed a non significant ($p > 0.05$) interaction between the groups across the experimental sessions in other parameters. While the results reported previously focused on the long-term effect, the immediate effect of the PMR training showed that 16 muscle groups PMR subjects has significantly lower SFs compare to control group. Besides that, both intervention groups improved ScAL after training session. The results also showed that control group takes significantly longer Ts from pre to post test. However, there were no significant interactions in Ss, Sc and coping response. In conclusion, 12 sessions of 16 muscle groups PMR training lead to significant improvements in heart rate, GSR mean of tonic skin conductance, choice reaction time and concentration ability. Besides that, it also has better immediate effect after practicing technique.

BAHAGIAN C

Biodata Abstrak Penyelidikan

COMPARISON OF THE EFFECTS OF TWO TYPES OF PROGRESSIVE MUSCLE RELAXATION (7 AND 16 MUSCLE GROUPS) ON SELECTED PSYCHOPHYSIOLOGICAL AND PSYCHOMOTOR PARAMETERS FOLLOWING REPEATED SUB-MAXIMAL INTENSITY EXERCISE IN YOUNG ATHLETES.

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Introduction: There are circumstances in sport performance when anxiety regulation is critical. There is a need to teach athletes to anxiety regulation technique such as Progressive Muscle Relaxation. Research in sports psychology suggests that Progressive Muscle Relaxation can have positive effects on athletes' performance by reducing wasted muscle activity and calming the physiology. In fact, there are numbers of studies have have shown the effectiveness of Progressive Muscle Relaxation technique. Despite all the convincing evidences, there are no concrete guidelines on the

PMR training (duration, frequency) need to be conducted before relaxation response is activated.

Objectives: This study aims to compare the effectiveness of different frequencies (6 and 12) of two types PMR (7 and 16 muscles groups) of different training durations (15 and 25 minutes) on selected psychophysiological and psychomotor parameters following repeated sub-maximal intensity exercise among young athletes.

Subjects and Methods: Twenty six physically active young males with the mean age 13.4 ± 0.5 years old, weight 50.8 ± 8.1 kg, BMI 19.2 ± 1.7 kg.m⁻¹, VO_{2max} 54.48 ± 6.67 ml.kg⁻¹.min⁻¹ and HR_{max} 201.7 ± 1.5 beats.min⁻¹ participated in this study. They were randomly assigned to the control group (n = 8) and two intervention groups: 16 muscle groups Progressive Muscle Relaxation (n = 9) and 7 muscle groups Progressive Muscle Relaxation (n = 9). Each participant was tested in three experimental sessions; pre-intervention, mid-intervention (after 6 sessions of relaxation training) and post-intervention (after 12 sessions of relaxation training). In every experimental evaluation, muscle electrical activity (EMG) and Galvanic Skin Response (GSR) were measured. For parameters such as oxygen consumption (VO_2), heart rate, rating of perceived exertion (RPE), choice reaction time, and concentration, the measurements were conducted only on experimental evaluation 1 and experimental evaluation 3. Experimental evaluations 1 and 3 consist of four trials, where subjects had to run at 60% VO_{2max} for 10 minutes followed by 90% VO_{2max} for 2 minutes in each trial. VO_2 , heart rate and RPE were recorded at the end of each trial. Then, it was followed by 3 minutes resting interval where choice reaction time and concentration (grid test) were

measured. Participants from the intervention groups attended the relaxation training program for 3 sessions per week for 4 weeks.

Results: The results of two-way repeated measure ANOVA revealed a significant ($p < 0.05$) interaction between groups across the experimental sessions in heart rate, GSR mean of tonic skin conductance (Sc), choice reaction time, and concentration grid test. Pair wise comparison analysis revealed a significant improvement in heart rate and concentration grid test for both intervention groups compare to control group. After 12 sessions of PMR training, 16 muscle groups PMR subjects showed a significant improvement in GSR mean of tonic skin conductance (Sc) and choice reaction time compare to control group. However, the results revealed a non significant ($p > 0.05$) interaction between the groups across the experimental sessions in other parameters. While the results reported previously focused on the long-term effect, the immediate effect of the PMR training showed that 16 muscle groups PMR subjects has significantly lower SFs compare to control group. Besides that, both intervention groups improved ScAL after training session. The results also showed that control group takes significantly longer Ts from pre to post test. However, there were no significant interactions in Ss, Sc and coping response.

Conclusion: In conclusion, 12 sessions of 16 muscle groups PMR training lead to significant improvements in heart rate, GSR mean of tonic skin conductance, choice reaction time and concentration ability. Besides that, it also has better immediate effect after practicing technique.

Dr Hairul Anuar Hashim: Supervisor

Dr Soumendra Saha: Co-Supervisor

CHAPTER 1

INTRODUCTION

1.1 Background and scope of the study

Stress can be defined as physical, mental or emotional demand, which tends to disturb the homeostasis of the body (Anshel, 2003). In sport performance, the physical and physiological demands may come from prolonged exhaustion effect from training (Silva, 1990), high intensity physical activity (McMorris et al., 2000), long duration performance (Masters & Ogles, 1998), and competition schedule (Navaneethan & Soundararajan, 2010). Athletes also have to deal with psychological stress such as worry, anxiety, nervousness, heighten level of arousal, and mental tiredness in their performance (Cox, 1998; Galluci, 2008). Successful sport performers have adopted different strategies which enable an effective coping response in high pressure situations (Jones et al., 1994).

There are some sports that require prolonged exposure to intermittent high intensity exercises (Hanafi et al., 2011). Certain sports such as football and many other team sports entail intermittent exercise with bouts of short, intense activity punctuating longer periods of low-level, moderate-intensity exercise (Reilly, 1996). There are many physiological stresses that require high levels of players' physical fitness without neglecting the importance of skill acquisition. The level of performance is commonly declines in the later or final stages of games and this deterioration has been attributed to fatigue (Hanafi et al., 2011; Reilly, 1996). A number of studies have described negative effects of strenuous physical activity on

cognitive task performance (Brisswalter et al., 1995; Hogervorst et al., 1996; Isaacs & Pohlman, 1991). During fatigue state, athletes' processing capabilities and cognitive process gets slower. This will lead to slower psychomotor reaction such as reaction time.

Besides physical stress, athletes are vulnerable to mental or psychological stress. Increase competitive pressure nowadays leads to higher mental stress among athletes. It is important for athletes to be able to handle and cope with the competitive anxiety and pressure in sport performance. Anxiety response associated with high state of arousal can result in ineffective performance, faulty decision making, and inappropriate perception (Williams, 2010). Athletes with high level of anxiety and worry often waste energy inappropriately that leads to fatigue. An athlete's psychological stresses may be manifested as somatic symptom such as muscle tension that interferes with the skill execution and coordinating movement. Therefore, anxiety and fatigue state of an athlete may deteriorate their sports performance.

There are several theoretical constructs that can explain the relationship of stress, anxiety and fatigue to performance. According to Multidimensional anxiety theory, maximal performance can be achieved only at moderate physiological arousal. Too high or too low arousal level will deteriorate performance (Jones et al., 1994). Another theoretical explanation that can be applied is Easterbrook's cue utilization theory. This theory proposed that high physical arousal resulted from exercise would lead to narrowing of attentional focus (Hanafi et al., 2011). As arousal further increase, relevant cues associated with the task are also blocked out

and therefore cognitive performance deteriorates. This theory suggested that moderate intensity exercise could improve reaction time whereas heavy exercise could deteriorate reaction time due to fatigue response (Collardeau et al., 2001). As athletes focus on their bodily sign fatigue response, they miss critical environmental cues that determine optimal performance (Gallucci, 2008).

There are many psychological skills and strategies intended to increase athletes' self-control during critical moment of sport performance. The deleterious effects of physical and psychological stress of sport performance can be reduced with relaxation techniques. Examples of relaxation techniques are Progressive Muscle Relaxation, autogenic training, imagery, biofeedback, hypnosis and meditation. All relaxation techniques yield physiological changes described as relaxation response. Relaxation response is defined as an opposite, involuntary response that causes a reduction in the activity of the sympathetic nervous system (Benson, 1974). The relaxation response brings body system back into balance after sympathetic activation response. Mastery of relaxation technique will benefit individuals by increasing attention, reducing anxiety, heart rate and muscle tension, and improving concentration (Hanafi et al., 2011).

The relaxation technique such as Progressive Muscle Relaxation can reduce cognitive anxiety (i.e. worry and self-doubt) and somatic anxiety (i.e. muscle tension), while increasing concentration on performance (Cox, 1998). It counteracts the stress response and regulates the activation of sympathetic nervous system (Manzoni et al., 2008). In Progressive Muscle Relaxation technique, an individual will alternately tense and relax muscle groups (Charlesworth et al., 1985). The

series of contracting and relaxing muscle groups help body to increase awareness about the sensation of tense versus relaxed muscle (Galluci, 2008; Charlesworth et al., 1985). Contracting the muscle teaches awareness and sensitivity to what muscle tension feels like, while relaxing the muscle teaches the absence of tension and how this can be voluntarily induced (Gill et al., 2004). Muscle relaxation can be induced by passively releasing tension in muscle (Gill et al., 2004).

Through the process of Progressive Muscle Relaxation training, athletes can become quite proficient at recognizing unwanted tension sensations wherever they may occur and release the tension voluntarily (Williams, 2010). When there is a decrease in the level of muscle tension, brain receives less information for sympathetic activation (Galluci, 2008). The effects of Progressive Muscle Relaxation are due to activation of parasympathetic branch of the autonomic nervous system, which then inhibits the sympathetic branch (Gallucci, 2008). Parasympathetic activation promotes rest and repair that leads to deepened sense of relaxation (Conrad & Roth, 2007). Parasympathetic response leads to decrease in oxygen consumption, heart rate, respiration, and skeletal muscle activity that reduced muscle tension (Cox, 1998). There are many evidences supporting the usage and positive influence of Progressive Muscle Relaxation on sport performance, medical condition and general wellbeing (Naveneethan & Saundararajan, 2010; Manzoni et al., 2008; Nickele et al., 2005).

Progressive Muscle Relaxation is a relaxation technique that has somatic attentional focus which emphasizes on contracting and relaxing muscles. Multi-process theory which incorporates a specific-effect hypothesis suggested that

Progressive Muscle Relaxation being a form of physical skill learning should have greatest effects on somatic anxiety (Ghonceh & Smith, 2004). Somatic component of Progressive Muscle Relaxation will activate particular subsystem variables which are sensitive to its component (Warrenburg et al., 1980). Therefore, it is expected that Progressive Muscle Relaxation will affect physiological parameters such as respiration oxygen consumption, heart rate, respiration rate, muscle activity and skin conductance. Developing a better understand of the specific-effects response would assist sport psychology practitioners to provide treatment approaches that meet the need and best match the symptoms of an athlete (Gill et al., 2004).

Although there are many studies that have investigated the effects of exercise on psychomotor and psychophysiological parameters, evidence of positive effects of Progressive Muscle Relaxation on psychomotor and psychophysiological parameters following repeated submaximal intensity is still lacking. Thus, this study is designed to fill this gap in the literature. Besides that, despite the existing evidence of the benefits of Progressive Muscle Relaxation technique on sport performance, several medical conditions and psychological disorders, there are no concrete guidelines on the training program or intervention of what technique duration and frequency need to be conducted before relaxation response is activated. Therefore, the main objective of this study is to investigate the effects of two types Progressive Muscle Relaxation (7 and 16 muscle groups) of different session's duration on selected psychophysiological parameters following repeated sub-maximal intensity exercise.

1.2 Problem statement

Many researches have indicated that Progressive Muscle Relaxation training program gives positive implications and benefits on athletic performance. There are evidences that show Progressive Muscle Relaxation technique leads to performance enhancement, coordination and concentration improvement, and anxiety reduction (Naveneethan & Saundararajan, 2010; Gallucci, 2008; Manzoni et al., 2008). Besides performance enhancement outcomes, Progressive Muscle Relaxation training is also affecting individual and athletes general wellbeing. Despite all the positive benefits of Progressive Muscle Relaxation, there are no concrete guidelines on the training program or intervention of the optimal training duration before the relaxation response is activated. There is also no guideline regarding the optimal sessions required before mastery of technique is achieved and effects are produced (Hanafi et al., 2011). In some cases, it requires only 5 sessions before the relaxation is activated, meanwhile in other studies, it require longer intervention sessions. Thus, studies investigating the effectiveness of different duration and frequency are needed in order to provide a more concrete guideline.

Progressive relaxation training is effective for many conditions, but it does not effective for all conditions. Possible reasons for such inconsistency may be related to methodological variations such as; 1) frequency of sessions (number of training sessions), 2) duration of each session, 3) script of Progressive Muscle Relaxation (long, medium, short), 4) background of participants (i.e., age, nature of sport involve, level of sport performance, experience in relaxation training), and 5)

measurement sessions (when effects are measured). By understanding the mechanism behind the effectiveness of Progressive Muscle Relaxation training, better predictions should be possible of the effectiveness of this technique for different settings and conditions (Gill et al., 2004). In sport performance, it is important for athletes to maintain their cognitive-motor performance during games and competition. Therefore, besides immediate effects of Progressive Muscle Relaxation, the long-term effects of this technique, especially in fatigue condition is worthy of further investigation.

1.3 Objectives of the study

The present study was undertaken with the aims to:

- 1.3.1 Compare the long-term effects of two types Progressive Muscle Relaxation (7 and 16 muscle groups) of different training durations (15 and 25 minutes) on selected psychophysiological parameters following repeated sub-maximal intensity exercise.
- 1.3.2 Compare the effects of different training frequencies (6 and 12 sessions) of two types Progressive Muscle Relaxation (7 and 16 muscle groups) on selected psychophysiological and psychomotor parameters following repeated sub-maximal intensity exercise.
- 1.3.3 Investigate the immediate effects of two types Progressive Muscle Relaxation training (7 and 16 muscle groups) on muscle activity and galvanic skin response.

1.4 Hypotheses

1.4.1 H₀ : There are no significant differences between two types Progressive Muscle Relaxation (7 and 16 muscle groups) of different durations (15 and 25 minutes) on choice reaction time, grid attention test, oxygen consumption, heart rate, and rating of perceived exertion.

H₁ : There are significant differences between two types Progressive Muscle Relaxation (7 and 16 muscle groups) of different durations (15 and 25 minutes) on choice reaction time, grid attention test, oxygen consumption, heart rate, and rating of perceived exertion.

1.4.2 H₀ : There are no significant differences between two types Progressive Muscle Relaxation (7 and 16 muscle groups) of different training frequencies (6 and 12 sessions) on muscle activity and galvanic skin response.

H₁ : There are significant differences between two types Progressive Muscle Relaxation (7 and 16 muscle groups) of different training frequencies (6 and 12 sessions) on muscle activity and galvanic skin response.

1.4.3 H₀ : There are no significant immediate effects of two types Progressive Muscle Relaxation (7 and 16 muscle groups) on muscle activity and galvanic skin response.

H₁ : There are significant immediate effects of two types Progressive Muscle Relaxation (7 and 16 muscle groups) on muscle activity and galvanic skin response.

1.5 Significance of the study

The results of the present study are expected to provide evidences on the optimal Progressive Muscle Relaxation training needs to be conducted before relaxation response is activated. Findings of this study are also expected to provide guideline of best practice of Progressive Muscle Relaxation training session duration and frequency that are optimal for best effect of relaxation. The results can potentially be useful in designing an effective Progressive Muscle Relaxation training program for athletes to improve their performance.

Moreover, most of the previous studies have focused on elite and university athletes at adult age, but studies on the impact of the mental training on young junior athletes have seldom been investigated. As mental skill training is best developed during the earlier stage of sport involvement, earlier exposure to psychological skill such as relaxation skill may assist young athletes' mental development.

1.6 Conceptual definitions

Stress: Physical, mental or emotional demand, which tends to disturb the homeostasis of the body (Anshel, 2003).

Arousal: The degree of physiological and psychological activation of the organs and mechanism that is under the control of the body's autonomic nervous system (Cox, 1998).

- Anxiety:** A negative emotional state with feeling of nervousness, worry and apprehension associated with activation arousal of the body (Weinberg et al., 1995).
- Chocking:** Reduced performance quality under pressure circumstances (Anshel, 2003).
- Fatigue:** Physical fatigue is an inability of a muscle to maintain optimal physical performance.
- Mental fatigue is a decrease in cognitive performance resulting from prolonged periods of cognitive activity.
- Muscle tension:** Conditions in which muscles of the body remain not completely relaxed for an extended period.
- Stress response:** Response to threats with a general discharge of the sympathetic nervous system.
- Relaxation:** The act of relaxing or the state of being relaxed that leads to refreshment of the body and mind and loosening of muscles.
- Attention:** A process which individuals selectively attend to stimuli in the environment or to their own thought.
- Psychomotor:** The relationship between cognitive function and physical movement.

Relaxation response:

A set of integrated physiological mechanisms and adjustments that are elicited when a subject engages in a repetitive mental or physical activity and passively ignores distracting thoughts (Manzoni, 2008).

Choice reaction time:

A measure of the speed of mental processing in which the subject has to choose between one of several stimulus is presented.

Rating of perceived exertion:

The degree of heaviness and strain experienced in physical work.

Repeated submaximal intensity exercise:

Repeated running that is equal to or greater than 70% HRmax and also equal to or less than 90% VO_2max .

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The psychological state of a sportsperson plays a vital role in his or her performance. Thus, psychological training in sport aims to promote positive sporting performance for performance enhancement. In order to enhance the psychological component of sports performance, psychological skills training has been recognized as an effective method (Behncke, 2004; Lane et al., 2009; Mansour, 2010; Matsumo & Smith., 2001; Navaneethan & Soundarajan, 2010; Paul, 1969). Psychological skills are learned behaviors that can be used by the athletes to regulate their performance using methods such as mental imagery and visualization, goal setting, biofeedback, meditation, cognitive-behavior therapy and progressive muscle relaxation (Murphy & Tammen, 1998). In recent years, there are increased numbers of research findings that support the effectiveness of psychological intervention such as relaxation technique to attain optimal sports performance. This study will focus on progressive muscle relaxation as main research component of psychological intervention. In this chapter, studies related to the effects of progressive muscle relaxation training on psychomotor, psychological, and physiological performance will be reviewed.

2.2 Psychological aspects of sport performance

2.2.1 Stress and anxiety in sport

An important aspect of competitive sports is the need for athletes to cope with the demands of competition and perform well under pressure (Craft et al., 2003). Competitive pressure in sports was found to lead to mental and physical stress among athletes (Navaneethan & Soundarajan., 2010). As the standard of all games has increased considerably, sport competition can generate much anxiety and worry (Williams, 2010).

Young athletes face considerable stress resulting from sport participation and competition (Left et al., 1994). Aspiring young athletes often find themselves stuck between studies and training. Juggling with their studies and their athletic commitment can be difficult and burdensome (Cohn, 2006). High-standard performance among junior athletes is associated with increased pressure. If those young athletes are not able to deal with such pressure, then the effect on performance is likely to be critical and even to the point that they will dropout from their sports participation (Woodman et al., 2003).

Jones et al. (1994) postulated that young athletes may interpret their stress and anxiety as being more debilitating to performance due to low self confidence in their own ability to control both themselves and the environment. Young athletes with poor self-confidence and low self-worth, who feel they have little control over situations, may experience more stress. According to a study done by American Committee on Sports Medicine and Fitness (2000), the increasing demands for

success create constant pressure for young athletes to train longer, harder, and more intelligently. The unending commitment and intensity of training raises concerns about the sensibility and safety of young athletes' involvement in competitive sport. Physical, physiologic, and psychologic tolerances to competitive stress in young athletes affect their growth development and general wellbeing (Woodman et al., 2003).

2.2.2 Stress and anxiety definition

Stress, anxiety and arousal are interrelated psychological constructs. However, they have been conceptually and operationally defined differently (Williams, 2010). Stress is defined as “the process that involves the perception of a substantial imbalance between environmental demand and response capabilities under conditions in which a failure to meet demands is perceived as having important consequences and is responded to with increased levels of cognitive and somatic state anxiety” (Martens et al., 1990).

Arousal is defined as the degree of physiological and psychological activation of the organs and mechanism that is under the control of the body's autonomic nervous system (Cox, 1998). On the other hand, anxiety is “a negative emotional state with feeling of nervousness, worry and apprehension associated with activation arousal of the body” (Weinberg et al., 1995).

Although stress, anxiety and arousal have different definitions, all these three constructs share similar management strategies such as goal setting, cognitive

restructuring, relaxation techniques and progressive muscle relaxation (Humara, 1999).

2.2.3 Stress response

Stress response can range from 'butterflies in the stomach', to extreme fear and panic, to avoidance of a competition. Loss of concentration, worry, rapid heart rate, nausea, stomach ache, fidgeting, restlessness, and fatigue are all signs of stress (Cox, 1998). Stress also leads to muscular tension, which in turn leads to pain, stiffness, and fatigue. Furthermore, excessive muscular tension caused by stress prevents appropriate coordinating movement that is crucial in sport performance (Williams, 2010).

An athlete's psychological stresses may be manifested as in the form of somatic complaints, such as sleep disturbance, irritability, fatigue, gastrointestinal disturbance, muscle tension and also injury (Conrad et al., 2007). Stress is also manifested in the form of perceived threat, such as worry and anxiety. Over activation of autonomic nervous system resulted from stress leads to detrimental effect on sports performance as it interferes with the execution of motor skill (Williams, 2010). For young athletes, pressure and stress are related to a number of negative outcomes such as somatic complaints, fears of failure, feelings of inadequacy, guilt, and high dispositional anxiety (Left et al., 1994).

2.2.4 Contributing factors

There are many factors that contribute to stress and anxiety in competitive sports performance. According to Navaneethan & Soundarajan (2010), reason for

anxiety and worry among volleyball players is because of pressure such as equal competition, concern about fulfilling the expectation of their teachers, coaches, parents and peer group and personal needs. Demanding situation in competitive sport leads to mental and physical stress. In another study, Left et al. (1994) stated that parental pressure can be one additional stressor to young athletes. The less parental pressure perceived by young athletes, the greater their enjoyment in sport and this leads to more positive sporting experience (Left et al., 1994).

Anshel (2003) suggested that anxiety is a result of perceived threat. It is a negative appraisal of a threatening situation. In sports competition, threats can come from the performer views of opponent superiority and evaluation of performance quality from other person such as coach and fans (Anshel, 2003). This can be so threatening especially for athletes with relatively low self confidence, low self esteem and lack of sporting experience because of their inability to control themselves and environment during such pressure situations (Jones et al., 1994). The combinations of an important meaningful event and doubts about own ability are the contributing factors that generate anxiety and worry (Williams, 2010).

2.2.5 Effect of stress on performance and health

Sportsperson should be concerned with how stress and competitive pressure affect athletic performance and general wellbeing. Many athletes struggle with competitive stress throughout their sports career. Each athlete reacts to stress differently and individually depends on their ability to cope and handle the competitive pressure (Fullerton, 2010). Competitive sports can generate much

anxiety and worry that can affect physiological, psychological and thought processes so that performance often deteriorates (Williams, 2010).

High level of physical stress and tension lead to performance decrement as the demands exceed the body ability to cope with it. In a study done by Mansour (2010), physical stressors that contribute to performance decrement of ballet students are such as overload on body systems, difficult motor skills and repeated cramps. These physical limitations arise during the beginning of ballet involvement where body still unable to cope and handle the physical demands of ballet requirement.

High level of stress plus the state of anxiety during competition or important match may narrow athletes' vision and attention. As the attention and vision narrowed, athletes' could not understand the things and situational requirement around them during their performance (Navaneethan & Soundarajan, 2010). Relevant information is gated out when the attention is narrowed. This leads to deterioration in athlete's performance as they cannot perform optimally. Hence having the high level of competitive stress, athletes are unable to show their real potential and effort in matches though they are having the needed physical and mental resources (Navaneethan & Soundarajan, 2010).

Stress is manifested by state anxiety (Pearlin et al., 1981). Physiologically, anxiety leads to fatigue. According to Weinberg (1977), athletes and individual with high anxiety have more unnecessary muscle activity and wasted energy before, during and after athletic activities. They contract agonist and antagonist muscle

groups simultaneously, and this bracing contributes to wasted muscular activity and inhibited coordination (Weinberg, 1977). Bracing is the principle of double pull in muscle. When a muscle tense up due to perceived stress, its opposite or antagonist sets up a countertension to hold the segment of the body in place (Willimas, 2010). The resulting double pull leads to high level of tension in the body. When excessive muscular tension occurs, it interferes with the skill execution and coordinating movement (Williams, 2010).

2.2.6 Stress framework

In order to explain stress, the stress process model is used as the guiding theoretical framework (Cox, 1998). Stress involved a source of threat or challenge from the environment and the person's cognitive appraisal of the environmental challenge or treat (Gallucci, 2008). According to Lazarus and Folkman (1984), stress is "a particular relationship between the person and the environment that is appraised by the person as taxing or exceeding his or her resources and endangering his or her well being" (Anshel, 2003; Gallucci, 2008). In sports field, competitions, performances, and evaluations are often threatening and stressful to the athletes. Therefore, performing in sport competitions always a stressor and stimulus that put high objective demand to the athletes. The athlete's appraisal process begins with an interpretation of whether the stressor or source of stress impact important areas of functioning and whether the athlete has resources adequate to cope with the magnitude of stress (Gallucci, 2008).

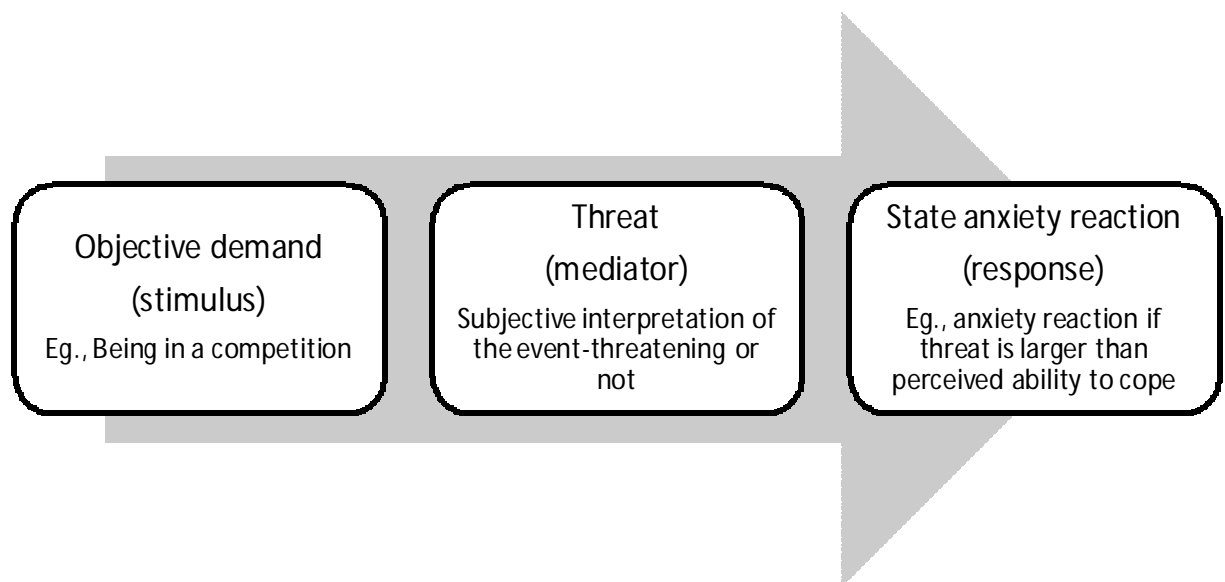


Figure 2.1 The stress process (Cox, 1998)

The objective demand represents the situation that the athletes placed in such as competition and big tournament; it is considered a stimulus. Athlete's subjective evaluation of the situation and the interactive effect of trait anxiety will determine whether the athlete sees the objective situation (competition) as threatening or not (Cox, 1998). Competitions may be interpreted as threatening and risky or as opportunities for advancement and recognition depends on the subjective interpretation of the event by the athlete (Gallucci, 2008). The perception of threat arises when the demands imposed upon an athlete are perceived to exceed his felt ability to cope with those demands (Cohen et al., 1986). The subjective interpretation of sources of stress is accompanied by emotional responses (Gallucci, 2008). State anxiety and worry may be generated by appraisal

of threat. Anxiety reaction may occur if threat is larger than perceived ability to cope. This model of stress involves interpretation of the meaning of the event and the interpretation of the adequacy of coping resources (Cohen et al., 1986). The relationship between objective situation and the response can also be explained in terms of imbalance (Cox, 1998). Distress will occur if the perceived demand is not balanced by the athlete's perception of his ability to respond effectively to the threat (Cox, 1998). The imbalance gives rise to the experience of stress and to a stress response that may be physiological and/or behavioral in nature (Cohen et al., 1986).

2.2.7 Multidimensional state anxiety

State anxiety reaction is a manifestation of stress (Cohen et al., 1986). Physiological response such as fatigue, muscle tension, and increase resting heart rate may occur as a result of demand and coping resources imbalance. According to multidimensional theory, anxiety consisted of cognitive and somatic components. Cognitive anxiety is caused by negative expectation and negative self-evaluation (Craft et al., 2003). On the other hand, somatic anxiety refers to the physiological response to anxiety that develop from autonomic arousal. In this theory, cognitive anxiety has been found to have a negative linear relationship with performance meanwhile for somatic anxiety has been found to have an inverted-U relationship with performance (Humara, 1999). Low and high levels of somatic anxiety may deteriorate performance (Jones et al., 1994). Thus, it is important to regulate or control somatic anxiety at moderate level so optimal performance can be achieved. Low cognitive anxiety and moderate somatic anxiety is the ideal level for optimal performance suggested by multidimensional theory (Figure 2.2).

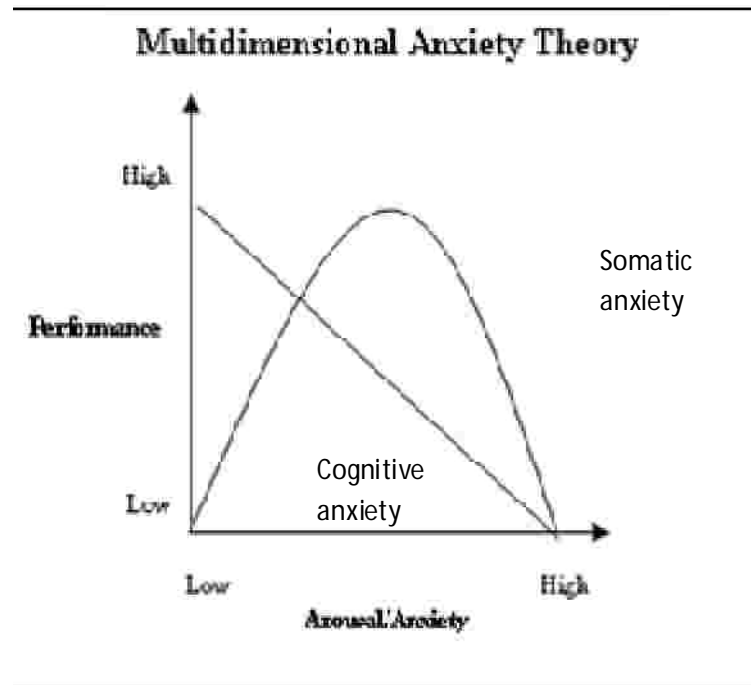


Figure 2.2 Multidimensional theory of anxiety

2.3 Relaxation response

Relaxation response is defined by a set of integrated physiological mechanisms and adjustments that are elicited when a subject engages in a repetitive mental or physical activity and passively ignores distracting thoughts (Manzoni et al., 2008). According to Benson (1974), relaxation response is an opposite, involuntary response that causes a reduction in the activity of the sympathetic nervous system. Relaxation response is the psychological and physiological contrast to the stress, 'fight or flight', response (Gill et al., 2004). This response provides a way of activating a part of the nervous system called the

parasympathetic nervous system. Parasympathetic nerve impulses lead to a slower heart rate, more regular respiration and general relaxation (Nickela et al., 2005).

The relaxation response brings body system back into balance. It slows body's respiration rate, reduces stress hormone, slows down the heart rate and blood pressure, and relax the muscles (Cox, 1998). According to Terathongkum and Pickler, (2004), relaxation response is associated with an increase in the cardiac parasympathetic tone. The relaxation response consists of the physiological changes that are opposite to the 'fight or flight' response of the sympathetic nervous system (Cox, 1998). The physiological changes are such as decrease in the oxygen consumption, heart rate, blood pressure, respiration, and skeletal muscle activity, while they increase skin resistance and alpha brain wave (Cox, 1998). Benson (1974) suggested that better prevention and therapy of disease to the fight or flight response might be achieved by activating the relaxation response.

2.4 Relaxation training

Accompanied by the increase in the level of competitiveness in sports, coaches and athletes realize that physical aspect alone may not be enough for peak performance. One factor of fluctuation in performance is caused by fluctuation in athlete's mental control (Williams, 2010). Performance drop during competition occurs when the athlete loses control of cognitive factors such as the ability to concentrate, maintain optimal motivation and inappropriate aroused (Williams, 2010).

Manzoni et al. (2008) stated that relaxation technique is one of the most used techniques in stress and anxiety management. Relaxation skills can help athlete to reduce mental (worry and self-doubt) and physical anxiety (shaking and muscle tension), while increasing concentration on performance (Cox, 1998). Relaxation techniques can counteract the stress response of anxiety and stress and therefore the overactivation of autonomic system can be controlled or regulated (Manzoni et al., 2008). Landers et al. (1991) suggested that athlete can use appropriate relaxation strategies to reduce activation as needed once he has identified his optimal level of arousal for maximizing performance.

Relaxation training can be divided into two; which are the somatic and cognitive relaxation technique. Somatic relaxation techniques are such as Progressive Muscle Relaxation, autogenic, and breathing exercise. Meditation, visualization, and imagery can be categorized as cognitive relaxation technique. The difference between two types of relaxation techniques depends on its target effect. Somatic based technique such as Progressive Muscle Relaxation focus more on somatic aspects of relaxation, meanwhile cognitive based techniques focus on mental aspects of relaxation. Most of the relaxation techniques have their own unique procedure but yield essentially the same physiological result (Cox, 1998). Specifically, all of these relaxation skill result in decrease in oxygen consumption, heart rate, respiration, and skeletal muscle activity, while they increase skin resistance and alpha brain waves (Cox, 1998).

From relaxation training such as Progressive Muscle Relaxation, athletes were thought to recognize unwanted tension and to release that tension. According

to Behncke (2004), somatic relaxation methods such as progressive muscle relaxation increase the level of self-awareness. This self-awareness contributes to self-monitoring and self-regulation that lead to improve performance especially in high pressure competitive sport. An important consideration in relaxation training is that it must be practiced regularly just like any other sport skills (Williams, 2010).

There are many evidences supporting the usage and positive influence of relaxation techniques on sport performance, medical condition and general wellbeing (Cheung et al., 2003; Fletcher & Hanton, 2001; Ghoncheh & Smith, 2004; Holmes & Roth, 1988; Matsumo & Smith, 2001; Terathongkum & Pickler, 2004; Warrenburg et al., 1980). For example, in a review of research done by Terathongkum and Pickler (2004), relaxation training result in decreased blood pressure and increased heart rate variability and parasympathetic activity. A reduced in heart rate variability is associated with cardiovascular disease, such as hypertension, and psychological factor such as stress, anxiety and panic disorder. The findings from this review also provide a rationale for the therapeutic use of relaxation techniques in nursing practice, particularly in individual with high stress level and with cardiovascular disease (Terathongkum & Pickler, 2004).

In another study conducted by Pawlow et al. (2003), relaxation training significantly reduced stress, anxiety and salivary cortisol production among adult with night eating syndrome. Night eating syndrome is a psychological eating disorder that has been found to occur during the period of stress. People with night eating disorder were shown to have higher score for depression (Pawlow et al., 2003). Relaxation training intervention conducted in this study was found to be