

The Combination of Relaxation Imagery with Instrumental Music, and Aromatherapy on Muscle Tone and Heart Rate in Student Athletes

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Abstract The aim of this study was to explore the combined effect of imagery with instrumental music, and aromatherapy on the muscle tone and heart rate in university student athletes. The participants were 20 student athletes at Burapha University (10 males and 10 females). The participants were randomized into two groups (10 in each group): 1) the seated rest group, and 2) the imagery with instrumental music and aromatherapy group. The instruments included a biofeedback measurement (microvolts: μV), a program comprising imagery with instrumental music, an ergometer bicycle, a lavender oil sprayer, and an heart-rate monitor. The experimental design included moderate exercise on an ergometer bicycle at 75% of maximum heart rate and a 1-minute rest before starting the experiment. The data were collected using pre/post tests and recorded in 4 states (recorded every 4 minutes). The statistics used to analyze the data were mean, standard deviation, and the Wilcoxon matched-pairs signed-ranks (WSR) test. The following results were found: 1. The EMG data means of quadriceps muscle decrease in the control group were 13.49, 9.26, 7.09, 4.30, and 2.41 μV . The means of the experimental group were 12.13, 6.02, 3.26, 1.99, and 0.96 μV . Moreover, The EMG analysis found a significant difference at .05 between the control and the experimental group in state 3. 2. The means of the measured heart rates decreased in the control group and were 151.40, 136.40, 122.20, 113.10, and 101.00 bmp. In addition, the means of the measured heart rates decreased in the experimental group and were 151.20, 112.20, 98.50, 87.70, and 82.40 bmp. The results of the HR analysis showed a significant difference at .05 in state 1 and state 4.

Keywords Relaxation Imagery, Instrumentals Music, Aromatherapy

1. Introduction

Sports in today's world involve high levels of competition in which all athletes face pressure in competition. One challenge for athletes in competition is to control their emotional state to remain stable as stress and anxiety are important factors affecting their performance. This effect may have consequences for athletes before, during, and after competition. Another important aspect is physical fatigue following competition. Another critical issue is athletes' physical condition resulting from insufficient recovery capacity which may result in their inability to use their physical strength to reach their performance potential and to apply the skills needed to compete in the next round. These factors will reduce the athlete's performance. Also, negative perceptions related to physical conditioning can cause the

loss of confidence and an increase in anxiety.

Participation in sporting events may cause increasing fatigue as energy reserves are depleted. In addition, the athlete may experience mental stress including anxiety which can result in the inability to apply one's full potential to competition. Therefore, physical recovery is an important factor for athletes. If they are able to recover rapidly following competition or exercise, the efficiency of their physical fitness for returning to exercise will also improve [1]. Not only physiological methods such as physical rehabilitation, enough rest, and drinking water with protein foods are needed, but also rehabilitation by psychological techniques that can control the mental state. Full recovery from exercise may take 30 minutes to 1 hour. Rest during the recovery period for 1 to 2 hours by sitting still is a common method. This allows various bodily systems to recover naturally from a sudden reduction of bodily function following high-intensity exercise. During this time, the body begins the process of recovery, such as ATP synthesis or the elimination of waste, such as lactic acid from the muscles bleeding [2]. Psychological skills training (PST) is one of the

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important components of sport psychology and aims to enhance performance and recovery time [3]. The use of imagery techniques is widely popular among sport psychology researchers and practitioners. Cumming [4] noted that imagery is also referred to as visualization or mental rehearsal. It refers to using all the senses (i.e., sight, touch, hearing, taste, and smell) to rehearse one's athletic performance in one's mind. [5] stated that imagery is the use of all the senses in order to create experiences in the mind and to visualize them using all five senses to enhance the experience. A review of the literature finds that in most sports, athletes use imagery to familiarize themselves with the task which benefits athletes. A benefit that should not be overlooked is that in the future, imagery will be used to help control anxiety and help athletes to recover more quickly [3].

Recent studies have applied imagery with instrumental music for athletes in order to relax and enhance performance. According to a study [6], which explored the effects of guided imagery for relaxation with instrumental music on psychophysiological states in athletes, examined 3 categories of instrumental music: imagery with music by Mozart, imagery with classical Thai music, and imagery with sounds of nature. (spoken language only was the control group). The study found that imagery with Mozart, Thai classical music, or sounds of nature reduced listeners' heart rates and improved the results of electromyography (EMG) in the trapezius muscle. Likewise, the amount of time to reach a state of relaxation was found to be significant in the Mozart and the Thai classical music conditions. This aligns with [7] study of the effect of relaxation training with imagery and instrumental music on physical relaxation and accuracy in the dart-throwing performance of young athletes. The researchers found that the group that received imagery accompanied by music for relaxation had a reduced level of anxiety and greater accuracy in throwing darts than the imagery group without music.

Instrumental music is music without lyrics and has been shown to have a more calming effect than contemporary music with lyrics. As [8] stated, music without lyrics may be more conducive to relaxation because listeners don't have to think about the lyrics and their meaning or think about following the lyrics. [9] Noted that music without lyrics does not convey meaning directly but that meaning can be conveyed by the melody, tempo, and harmony, which affect the mood of the listener. Other studies also found that the use of imagery with instrumental music has more positive results related to athletes' feeling more relaxed. However, to induce a feeling of relaxation in athletes with the use of imagery, four of the senses, i.e., visual, auditory, and tactile, are specified. There is still a lack of research related to the use of the olfactory sense to create mental images and perceptions especially relaxation that may be effective for helping athletes to reach a state of relaxation more quickly.

Aromatherapy is the science and art of using the aroma of essential oils from natural plants. Aromatherapy is a form of alternative medicine that is used to help treat physical and mental conditions affecting the central nervous system

(e.g., for the relief of anxiety and to aid relaxation). It is also used to stimulate the body and the mind to create balance for better health, including the prevention of non-life-threatening illnesses. Essential oils have been found to have a number of benefits; these include reducing stress and anxiety, increasing energy and stimulation, providing a feeling of being refreshed and revitalized, inducing calmness, improving concentration, reducing inflammation and pain, and helping the body to resolve abnormal symptoms [10]. [11] Found that lavender oil, rosemary oil, jasmine oil, and citronella oil are those used most often in Thailand.

The relationship between emotional responses and brainwaves has been shown to have positive effects. In regard to relaxation with alpha brainwaves and beta brain waves with relaxation for feeling refreshed, a reverse relationship has been identified. The results of this experiment can be used as scientific data to support that essential oils have a profound effect on humans both physically and emotionally. Research conducted mostly in Thailand has shown that the use of lavender essential oil has a relaxing effect; therefore, lavender is a good choice for use in relaxation studies according to [12]. These researchers found that using lavender essential oil in aromatherapy and exercising on a treadmill for 15 minutes showed no significant differences between the groups. However, the study found that the exercise effort tended to decrease in the group receiving lavender aromatherapy.

To the best of our knowledge, no research can be found that has applied the science of aromatherapy to imagery with instrumental music. The purpose of this research was to investigate relaxation imagery with instrumental music and aromatherapy and the effects on the electromyography and heart-rate measurements of university student athletes as an alternative method for managing muscle relaxation and heart rate for athletes' physical recovery.

2. Research Question

The research question is: What is the effect of relaxation imagery with instrumental music and aromatherapy on the electromyography and heart-rate measurements on university student athletes' recovery following exercise?

3. Methodology

Participants were 20 student athletes (10 males and 10 females) of Burapha University between the ages of 17 and 21 years. The exercise consisted of 20 contact sports such as football, judo, taekwondo, rugby, and boxing. Participation was voluntary, and a random sampling method was used to divide the participants into 2 groups (Group 1: relaxation imagery with instrumental music and aromatherapy; Group 2: control).

Inclusion and exclusion criteria

To ensure a proper sample, the researchers considered the following selection criteria in order to consider this sample

representative of the studied population:

1. None of the potential participants had ever had experience practicing imagery with instrumental music or the imagery with instrumental music combined with the use of aromatherapy.
2. All potential participants were healthy. No medical conditions were noted according to responses for the Physical Activity Readiness Questionnaire (PAR-Q); subjects were determined to be healthy and to have normal hearing.
3. All potential participants were satisfied with the aroma of lavender essential oil according to the preference criteria.
4. None had a history of allergic reaction or irritation to lavender essential oil.

Research Instrument

The instruments used in the experiment to collect data for this research consisted of the following:

1. An electromyography monitoring device (MIND MEDIA Nexun-4 brand) is used to measure electrical conductivity to recognize the function of striped muscles and the contraction that are in tension or looseness, which is measured at the position of the muscles. The quadriceps muscle, measured by bringing the electrode to the desired position, will be displayed via a BioTrace+ program.
2. A relaxation imagery program with instrumentals music for 16 minutes following Intrarak (7), the examples relaxation guided imagery was following: First session "Follow by guide recommendation", "Slowly inhale and exhale", "Relax your shoulders", "Comfort, and relax".
Second session "Think about the water that flows continuously. The water is clear and cool, which makes us feel relaxed", "Think of the impressive image of goodness and happiness".
Last session "Think of success, pride, and happiness". In addition, music is played at a rhythm of approximately 69 ± 2 beats per minute from three modern songs 16 minutes approximately.
3. Monark bicycle model 828E
4. Aroma sprayer model 3AIOOTM for lavender essential oil
5. Polar FT7 heart-rate monitors watch
6. Hygrometer to measure the humidity of the air in the laboratory
7. Thermometer to measure the temperature in the laboratory

4. Research Procedure

The experiment was conducted using the following steps.

1. Ethical approval was granted by the Burapha University committee (Sci 010/2561).
2. The experiment will focus on health and include basic

health checks such as blood pressure measurement and body temperature.

3. In the cycling ergometer test, measurement work began with adjusting the seat level on the bike to be suitable for each subject. This protocol followed a study by Aonnom [13] that included a warm-up by experimenting with bicycles to measure work to adjust the cycle before starting the experiment (3 minutes), and then cycling was started to measure work at a weight of 50 watts by increasing the weight by 5 watts every 2 minutes until the participant was unable maintain the cycle (amount 50 cycles per minute). The researchers considered the heart rate at 75 percent of the maximum pulse combined to ensure that each subject had exercised by cycling to measure the full capacity. After that, the weight was gradually reduced for about 3 minutes before quitting. (For the person taking the test to adjust his or her physical condition before getting off the bike, the amount of work was measured.). The experimental program as follows figure 1

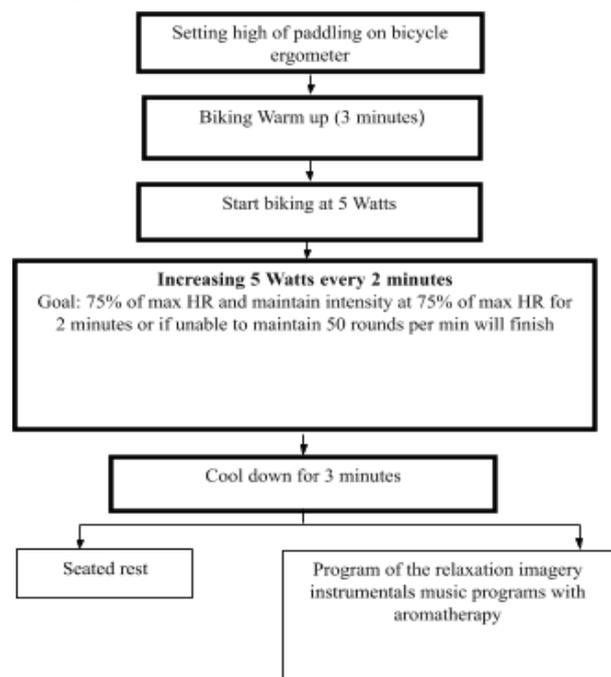


Figure 1. Show the procedure protocol

1. The control group (Group 1) in the seated rest program was comprised of 10 subjects (5 females and 5 males). They sat on a chair with their eyes closed in a laboratory for 16 minutes with the temperature controlled at 25°C and the humidity 30%–50%.
2. The experimental group (Group 2) received relaxation imagery instrumentals music programs with aromatherapy (5 females and 5 males) by sitting on a chair for 16 minutes with their eyes closed while beginning to receive relaxation imagery instrumentals music programs with aromatherapy. At the same time, they inhaled air that had an essential oil spraying

device located 50 cm. to the subjects' right at a ratio of 1 liter of water to 0.5 cc of lavender essential oil; the temperature in the laboratory was again controlled at 25°C and the humidity value was 30%–50%.

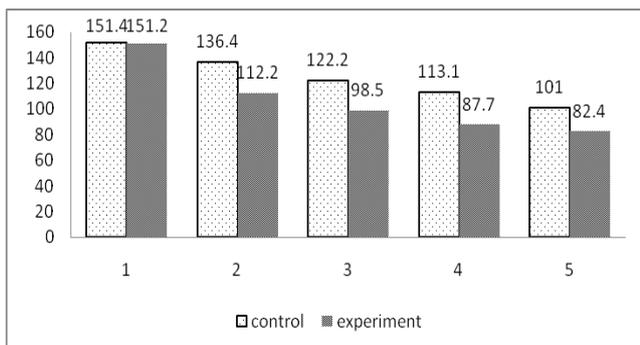
5. Statistical Analysis

1. Basic statistics used in the data analysis were mean and standard deviation.
2. Statistics used for hypothesis testing include a comparison of the results of loosening the quadriceps muscles and the heart rate between the two groups every 4 minutes using Wilcoxon matched-pairs signed-ranks (WSR) test.

6. Result

Table 1. Shows the results of the HR mean scores of the participants in the control and experimental groups

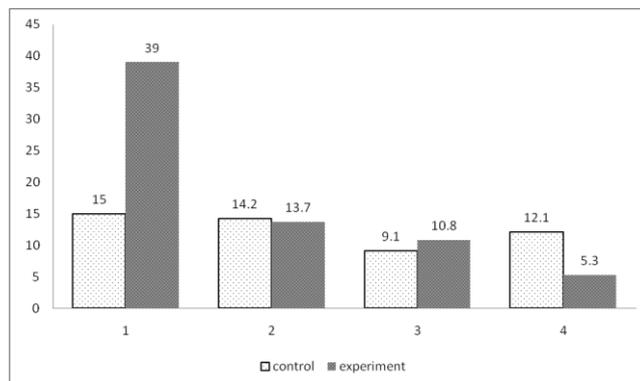
	Mean (unit: bpm)	
	Control group (N = 10)	Control group (N = 10)
HR pretest	151.4	151.2
HR at 1st state	136.4	112.2
HR at 2nd state	122.2	98.5
HR at 3rd state	113.1	87.7
HR at 4th state	101	82.4



Bar Chart 1. Shows the HR data of the participants

Table 2. Shows the results of the HR mean difference scores of the participants in the control and experimental groups

HR	Mean difference Mean (unit: bpm)		Mean difference between Control group and Experimental group
	Control group (N = 10)	Experimental group (N = 10)	
Pretest– 1st state	15	39	24
1st state–2nd state	14.2	13.7	0.5
2nd state–3rd state	9.1	10.8	1.7
3rd state–4th state	12.1	5.3	6.8



* Significant at 0.05

Bar Chart 2. Shows the HR data of mean differences state 1-4 of the experiment with the participants

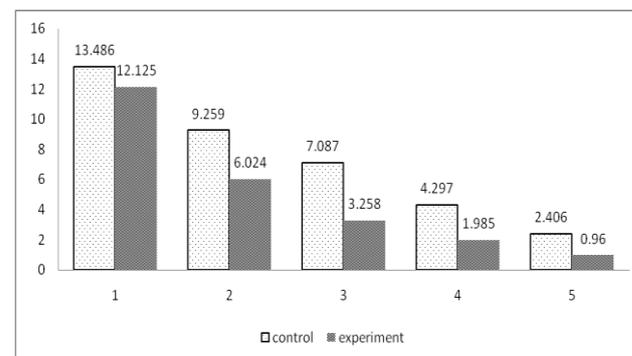
Table 3. Shows the results of the HR of mean differences score comparison between the trial periods of the participants

Variable	N	Z	Asymp. Sig. (2-tailed)
meandife1 - meandif1	10	-2.805b	.005
meandife2 - meandif2	10	-.255c	.799
meandife3 - meandif3	10	-.771b	.440
meandife4 - meandif4	10	-2.662c	.008

The results of the HR analysis using the Wilcoxon matched-pairs signed-ranks (WSR) test shows that the differences between the control and experimental groups were significant at .05 in state 1 and state 4.

Table 4. Shows the results of the EMG mean scores of the participants in the control and experimental groups

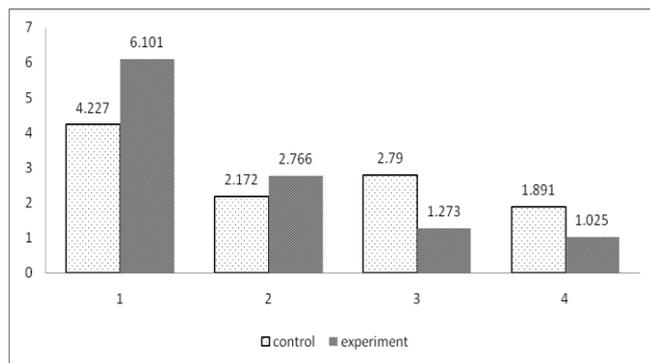
EMG	Mean (unit: μV)	
	Control group (N = 10)	Experimental group (N = 10)
EMG pre	13.486	12.125
EMG at 1st state	9.259	6.024
EMG at 2nd state	7.087	3.258
EMG at 3rd state	4.297	1.985
EMG at 4th state	2.406	0.96



Bar Chart 3. Shows the HR data for the participants

Table 5. Shows the results of the EMG mean difference scores of the participants in the control and experiment groups

EMG	Mean difference Mean (unit: μV)		Mean difference between Control group and Experimental group
	Control group (N = 10)	Experimental group (N = 10)	
Pretest–1st state	4.227	6.101	1.874
1st state–2nd state	2.172	2.766	0.594
2nd state–3rd state	2.79	1.273	1.517
3rd state–4th state	1.891	1.025	0.866



* Significant at 0.05

Bar Chart 4. Shows the HR data for the mean differences before, during and after the experiment

Table 6. shows the results of the EMG mean scores compared between the trial periods of the participants

Variable	N	Z	Asymp. Sig. (2-tailed)
EMGmeanfife1 – EMGmeanfifc1	10	-1.580b	.114
EMGmeanfife2 – EMGmeanfifc2	10	-.357b	.721
EMGmeanfife3 – EMGmeanfifc3	10	-2.701c	.007
EMGmeanfife4 – EMGmeanfifc4	10	-1.682c	.093

The results of the EMG analysis by Wilcoxon matched-pairs signed-ranks (WSR) test found that the differences between the control and experimental groups were significant in state 3 at .05.

7. Discussion

The aim of this study was to establish an alternative recovery technique for athletes who competed in a sport in which the competition was completed within one day. The sports included taekwondo, judo, karatedo, and others. The purpose of this experimental research was to compare the results of the relaxation of the quadriceps muscles and heart rate. The experiment combined relaxation imagery, instrumental music, and aromatherapy as a recovery program for athletes following moderate to heavy exercise. The results are discussed below.

Both the relaxation program group and the control group experienced relaxation as measured by a decrease in the tone of the quadriceps muscles and in the heart rates of the student athletes. For this research, the experiment was conducted in a sport psychology laboratory with a controlled air temperature of 25°C and humidity at 30–50%; these conditions were chosen because it has been found that the human body will recover from exercise naturally in this environment. For this research, the experimental design was set up with participants at seated rest in the laboratory temperature control 25°C, meaning that physical recovery may occur automatically. The recovery technique requires a beneficial temperature. Thus, for this research, the control group was at seated rest in a lab at 25°C. These conditions have good results for decreasing muscle tension and heart rate. However, the heart-rate data for the control group followed a trend of continually decreasing but not reaching a mean resting heart-rate level, which was found to require more than 16 minutes. We found that a program combining relaxation imagery with instrumental music and aromatherapy helped to relax muscle tone and reduce heart rate in athletes more effectively than seated rest alone.

Previous research [6,7] has shown good results for combining relaxation imagery with instrumental music both for psychophysiological variables and performance in a sport setting. Studies have used guided relaxation imagery combined with instrumental music with a rhythmic rate of approximately 69 bpm. [6] found benefits of a relaxation program composed of relaxation imagery and instrumental music together, including the amount of time needed to enter a state of relaxation. Data found only the imagery with music by Mozart and imagery with classical Thai music significantly decreased heart rate and the electromyography of the trapezius muscle. Therefore, these results confirm that the effect of imagery with instrumental music was to produce a state of relaxation more effectively than imagery alone.

The effect of music to help release stress has been well established and music has been used for this purpose for a long time. It is known to stimulate the brain and the senses, resulting in a physiological response. Relaxation depends on the kind of music that is heard and how it affects emotional expression and the feelings of the listener. Instrumental music is one type of music without lyrics that is played in the background with the use of guided imagery. [14] reported the “Mozart effect,” the first instrumental music to be found to positively influence learning and cognitive abilities.

The use of instrumental music indicated a more efficient and faster recall of events or feelings from listening to emotionally touching music. Listening to music can release emotions through the melody, harmony, and rhythm of the music and lead to feelings of deep relaxation. The effects of listening to instrumental music on concurrent mental processing are controversial. Overall, however, listening to music appears to have positive effects on emotions [15]. [16] evaluated the effects of a slow beat on pulse rate and blood pressure in healthy young adults and found a significant

reduction in both after listening to slow music. [17] used music with 60 beats per minute falling gradually to 50 bpm and found that the heart rate slowed down as a result. [18] reported data showing that slow music has a beneficial effect on reducing heart rate. Moreover, when music was used for athletic recovery, they approached relaxation; we used a guided imagery relaxation program to combine a couple of benefits for enhancing athletes' relaxation, in line with past studies [6,7].

Music affects the body and mind through the auditory apparatus and nerves and the effects are relayed to the brain, thalamus, and cerebral cortex. In consciousness, music will adjust the mood, feeling, and thinking of the cortical part of the upper brain, and the sensations pass into the cerebellum through nerve pathways that stimulate the autonomic nervous system [19]. Therefore, this will affect the individual in terms of interests, ideas, motivation, memories, and imagination; in short, when music is used, it can stimulate changes in various fields.

The important reason for recovery relaxation with imagery including instrumental music program combined with aromatherapy is more effective for decreasing muscle tone and the heart rate in athletes is that aromatherapy addresses one of the five senses, the olfactory sense with the mechanism of action being inhaling the odor into the nasal passages to the sensory nerves, where oligonucleotides are forwarded to the limbic system to direct the pituitary gland to produce hormones such as enkephalins, serotonin, and endorphins. Lavender essential oil has been shown to be effective in reducing pain, and it helps relax and calm those who inhale its aroma. It also has an enhancing positive relationship (relaxation with alpha brain waves) and the functioning of the autonomic nervous system.

These findings are consistent with [11] on the effects of essential oils on physiology and emotions, which showed a positive relationship between the emotional response and brainwaves in both relationships (relaxation with alpha brainwaves). In this research, the data show a loosening of the muscle tone in the thigh and a reduced heart rate in the experimental group, leading to physical recovery after moderate exercise within a short time before reaching the body's normal state. This is clearly demonstrated by imagery, and inhaling an aroma can achieve true awareness. Second, the combination of imagery and aromatherapy produced a real effect on psychophysiological factors (body and mind). Third, this technique of recognition using memory can interact with the olfactory experience of appropriate stimulation with a correspondence between imagery and aromatherapy as a significant stimulant for emotional reactions [20]. [21] found that lavender essential oil had an effect on brain function of producing images as well as the actual aroma.

Recovery from exercise is important for exercise energy. If athletes are able to recover quickly, their performance efficiency will improve. [22] explained that after high-intensity exercise, what is absolutely necessary is to restore the body to a normal state quickly for a more

effective recovery, which makes fatigue less likely and replenishes reserved ATP PC. [23] examined recovery techniques using imagery and music and found that these are also part of effective rehabilitation for athletes.

There are various techniques for restoring the body's normal state during a short rest (less than 30 minutes). Each sport has a different form of competition, and some have competitions that are completed in a single day. This leaves a short time for recovery. Such sports include tennis, judo, taekwondo, and others. This causes accumulated fatigue from overuse. Stress and anxiety also affect the next round of competition, resulting in the inability to fully utilize the efficiency of physical performance. Thus, especially for these sports, effective recovery is a necessary condition for successful competition. Removal of waste from fatigued muscles allows for enhanced transport of nutrients and oxygen to muscle cells, which will speed up the process of energy adjustment and compensation. Rapid recovery helps the athlete be ready to prepare for competition again.

The weaknesses of this study include a relatively small sample group, causing the statistics to be non-referenced to the general population. In a laboratory, all the required conditions can be established, but they are unlikely to be applied to real-world athletic competition situations. For example, after the first round and resting for the next round of taekwondo, it may not be possible to control room temperature and actual rest time limit. Thus, further research is needed that includes a rest period of more than 16 minutes. This study did not test physical fitness that would have an effect in the rehabilitation in athletes.

8. Conclusions

From the present study, it can be concluded that relaxation imagery with an instrumental music program in conjunction with aromatherapy can be effective for reducing athletes' heart rates to a resting state and decreases muscle tone after moderate exercise intensity to 70% of the maximum heart rate. Especially notable is that the heart rate declined significantly in the first four minutes and in the final stage of the experiment. However, the EMG data show a continuous decline from the first stage to the final stage, while a difference was found in the data for the control group in stage 3. Thus, this program appears to be beneficial for the effective recovery of athletes.

REFERENCES

- [1] Power, S.K., & Howley, E/T. 2001. Exercise physiology theory and application to fitness and performance (6th ed.). Seoul: Life Science Publishing.
- [2] Phuchan, P. 1992. Sport Science. Bangkok: Odien Store.
- [3] Singnoy, C. 2013. Sports Psychology. Faculty of Sport Science, Burapha Univesity.

- [4] William, S.E. and Cumming, J. 2004. *The Sport Imagery Ability Questionnaire Manual*. Birmingham, UK: Authors. voluntary exhaustion on exercisers with different goals and gender. Faculty of Sport Science, Burapha Univesity.
- [5] Boonverabut, S. 1998. *Sports Psychology*. Chonburi: Chonburi printing.
- [6] Singnoy, C. 2015. The Effect of Using Guided Imagery for Relaxation with three type of Music on Heart Rate, Electromyography (EMG) and time into a state of relaxation in Athletes. *Journal of Sports Science and Technology*. 15(2): 389-404.
- [7] Intarak, C. 2016. Effects of Relaxing and Arousing Music during Imagery Training on Dart-Throwing Performance, Physiological Arousal Indices, and Competitive State Anxiety. Faculty of Sport Science, Burapha Univesity.
- [8] Guzzetta, C.E. 1995. Music therapy: Hearing the melody of the soul. In Dossey L, Keegn CE, Guzzetta CE, & Kolkmeier LG (Eds.), *A hand book for practice* (2nd ed.) (pp.670-698). Maryland: Aspen.
- [9] Allsup, RE. 2011. Classical musicians and popular music: Strategies and perspectives. *Music Educators Journal*, 97(3), 30-34.
- [10] Wongkongkathep. S. *Thai Traditional Medicine, Indigenous Medicine and Alternative Medicine 2014-2016*. translator, Narin Tima. Aromatherapy textbook. Bangkok, (2018).
- [11] Sayorwon, W. 2011. Effects of selected volatile oils commonly used in Thailand on physiological activities and emotions. College of Public Health Sciences, Chulalongkorn University.
- [12] Srisuphonkornkun, K., Wiraphan, O., Pisuthanan, N., Mananuch, S., Songthan, A., and Muangchun, A. 2006. Effects of Aromatherapy on the change of Heart rate And the Effort value while exercising. *Journal of Sports Science and Technology*. 6(2): 115-126.
- [13] Annom, E. 2007. Effects of music on progressive cycling to
- [14] Rauscher, F.H., Shaw, G.L., & Ky, K.N. 1993. Music and spatial task performance. *Nature* 365, 611. doi: 10.1038/365611a0.
- [15] Kämpfe, J., Sedlmeier, P., and Renkewitz, F. 2010. The impact of instrumentals music on adult listeners: a meta-analysis. *Psychol. Music*. 39, 424-448.
- [16] Suguna, S., and Deepika, K. 2017. The effects of music on pulse rate and blood pressure in healthy young adults. 5(12), 5268-5272.
- [17] Agrawal, A., Makhijani, N., Valentini, P. 2013. The effect of music on heart rate. *J Emerg Investig*. 25:1-5.
- [18] Loomba, R.S., Loomba, R.S., Shah, P.H., Chandrasekar, S., and Molnar, R. 2012. Effects of music on systolic blood pressure, diastolic blood pressure and heart rate: a meta-analysis. *Ind Heart J*. 309-313.
- [19] Jäncke, L. Music, memory and emotion. *Journal of Biology*, 2008, 7(6), 21.
- [20] Rouby, C., Schaal, B., Dubois, D., Gervais, R., and Holle, A. 2002. *Olfaction, taste and cognition* (Eds.). Cambridge: Cambridge University Press. 140-159.
- [21] Lorig, T.S., and Roberts, M. 1990. Odor and cognitive alteration of the contingent negative variation. *Chemical Senses*. 15: 537-545.
- [22] Triphoem, J. 2011. The effect of cold treatment on recovery of Thai amateur boxers. Faculty of Sport Science, Srinakharinwirot University.
- [23] Tongho, I. 2016. Effect of Recovery after Exercise methods on Lactic acid in the Blood, Heart rate and Anaerobic Performance in Athletes. Faculty of Sport Science, Burapha University.