GESDAV

Journal of Behavioral Health

available at www.scopemed.org

Original Research

A comparison of relaxation therapies on salivary cortisol and its relation with sports performance

Shaji John Kachanathu[1], Satish Kumar Verma[2], Gulshan Lal Khanna[3]

[1]Researcher, College of Applied Medical Sciences, King Saud University, KSA,
[2]Professor, Department of Sports Sciences, Punjabi University, India,
[3]Dean, Faculty of Applied Medical Sciences, Manav Rachna International University, India

Received: January 13, 2012

Accepted: March 03, 2012

Published Online: March 04, 2012

DOI: 10.5455/jbh.20120303101351

Corresponding Author:
Shaji John Kachanathu,
King Saud University
johnsphysio@gmail.com

Key words:
Pre-competition Stress, Music Therapy, Meditation Therapy, Combination Therapy Shooting Performance.

Abstract
Background: Different studies have been discussed about the pre-competition stress (PCS) based on Salivary Cortisol (SC) and its response to relaxation therapies such as of Music Therapy (MT) and Mindfulness Meditation Therapy (MMT) in sports performance separately, but little has been done on the comparison of MT, MMT and its Combination Therapy (CT) effects on SC in sports performance especially in shooters in a single study.
Objective: The purpose of the current study was to estimate the contribution among MT, MMT and CT training on PCS by psychophysiological basis and its effect on sports performance of shooters.
Methods: 153 professional male Shooters age of 29.5±4.3years were examined in three groups. MT, MMT, and as a CT, n= 50±3 in each group. Duration of the study was for 4 weeks. Pre and post data of quantitative phenotypic markers of HPA- Axis by SC and Performance Score (PS) were analyzed on baseline and 29th day.
Results: All three experimental groups have shown positive correlation on post-intervention SC and PS, although CT group has shown highly significant ($p<0.0001$) result. Ultimately resulted in reduction of PCS level and increase in PS. When compared MT and MMT, MT shown marginal improvement than MMT group.
Conclusions: Results of this study concluded that relaxation therapies such as MT and MMT interventions along with routine sports specific training may decrease PCS and will enhance sports performance and found CT is more effective than MT and MMT alone and also found MT has been shown better effectiveness than MMT in 4 weeks of training.

INTRODUCTION

Competition stress is a widely prevalent condition that exists among athletes of all levels and within every sport. Stress is most often used to describe an unpleasant emotional state or condition which is characterized by subjective feelings of tension, apprehension, and worry. In sports context it is commonly known as pre-competition stress or anxiety. Further, research indicated that anxiety has a negative effect on these sport outcomes [1]. Studies on how athletes cope with sport-related stress has been recognized for both its practical and its theoretical importance because of the debilitating effects that stress may have on athletic performance. Study suggested that, prior to competing, sport performers' encounter more stressors pertinent to performance, these observations highlight that all the demands faced by athletes should be considered when preparing and implementing interventions to manage competition stress [2]. PCS relationship to performance has been studied both in and out of the sport context through anxiety researches within athletes [3, 4, 5]. Studies have been conducted to discover or identify the sources of stress in various competitive sports, including basketball [6], golf [7], and wrestling [8]. A recent meta-analysis examined the effects of competitive anxiety and self-confidence on athletic performance [9]. Anxiety and stress decreases the concentration and

performance level of sports persons [10]. Sport Psychology may be important variable in improving performance in an assortment of sports skills. Integrating psychology into daily life, including practices, competitions, and exercises may also assist the athletes to prevent "choking" susceptible situations. Learning the psychological skills taught in sport psychology may help athletes to handle choking situations better or even prevent them from happening [11]. Despite the large body of researches on PCS, our understanding on relaxation therapies and its relationship to performance remains elusive. A recent review has presented a strong case for the mood-enhancing effects of music in a sport context [12]. Studies supported that music found to be an effective tool for improving athletic performance [13]. The techniques of MMT, which focus on awareness to develop a detached observation of the contents of consciousness, may represent a powerful cognitive behavioral coping strategy for transforming the ways in which we respond to life events [14]. Even though many studies on MMPs have been criticized for the lack of scientific rigor, including the lack of high quality randomized controlled studies designed to differentiate between the specific (i.e. specifically related to repeated sitting meditation practice) and the non specific (i.e. related to benefits' expectations) effects of such practices [15] and the frequent use of self report instruments as measures of clinical improvements following mindfulness training [16]. Relaxation techniques have been used in sports primarily to enhance recovery from training and competition, manage anxiety and improve performance [17].

Pistol shooting is a static activity requiring a strict control of body segments and posture to align the rear sight aperture and the foresight through proprioceptive feedback and gaze fixation either on the target directly or between the target and the weapon and, therefore, to increase precision of the shot [18]. The important use of vision for shooting, leading to compensation through subconscious postural mechanisms based on proprioceptive and vestibular information, such as a less elevation of pre-shot heart rate and blood pressure, a lower sweating and a more appropriate preparatory brain activity [19].

Athletic trainers, physical therapists, coaches, parents, and athletes themselves are all responsible for learning and utilizing the fundamentals of psychological skills used in relaxation therapies. The present study focused on examining the relation of relaxation therapies response to skilled sport performance, and investigated the relevance of relaxation therapies in PCS in improving PS. While a number of studies have been examined both psychological and physiological factors related to sports performance, to our knowledge, this is the first single study to compare the efficacy among MT, MMT and Combination of both based on quantitative phenotypic markers of HPA- Axis by SC and Performance Score (PS) in professional shooters.

MATERIALS AND METHODS

Subjects; A total of 153 healthy male elite level shooters aged (29.5±4.3yrs.) selected in the present study and were voluntarily recruited from national shooting team, India; permission was obtained from chief coach. No volunteers are included as per exclusion criteria such as any physical or mental illness, hearing impairment, and have been undergoing neither MT nor MMT for last 3 months. All subjects were non-smokers, medication-free and not habitual drinkers. The procedures involved and potential risks of the study were explained to the subjects, and the written consent was obtained prior to the study. The study and all protocols were approved by research committee of Punjabi University.

Procedure; The relaxation intervention programs consisted of three components: (1) MT (2) MMT (3) CT (combination of both MT and MMT). 165 Participants were randomly allocated into these three groups by multiple blocked randomization, 55 in each group, after the dropout 153 (50±3) subjects could complete the study. Basic physiological parameters such as Heart Rate (70±3bpm), Respiratory Rate (15±2rpm), Body Mass Index (24±1.04kg/cm2) and Blood Pressure (119±4/79±4 mm of Hg) were monitored prior to study. Intervention trial was conducted to the respective subjects one week prior to the study. Concerning impediments to effective practice, subjects were monitored by the researcher and experts during the interventions. The interventions were provided over the course of 4 weeks, group sessions with a maximum of 8 participants each, 20 minutes session per day, 6 days a week and one day was off. Participants were asked not to consume caffeine or alcoholic beverages for 12 h, and not to exercise for 12 h prior to the experiment especially during testing. They were requested to refrain from eating and drinking for at least 3 h prior to the experiment. The all participants of each batch reported to the laboratory at 08:00AM, each session conducted in the morning (between 8 AM and 10 AM) and The subject changed into loose fitting clothing, and shoes removed then the participants were instructed to lie in the supine position on the floor mat in a quiet, room with the temperature between 24 and 28 °C with their eyes closed.

Interventions; MT: CD of 30-40 music of classical based songs given to the MT subject 1 week prior to the study and asked them to select 5-10 songs

according to their choice from the songs given , and were made separate folder for each subjects. The music was delivered on SonyTM MP3 player by headphone with volume of 60-70 dB, 60 to 70 beats per minute. The MT group was encouraged to assume a comfortable position in supine position on a floor mat during delivery of the music intervention, advised subjects to clear their minds and allow their muscles to relax throughout the training session and left the room after 20 minutes of session.

MMT: The first step in performing a meditation was to adopt a posture that ensures an erect spine and shoulder resting on the mat, with the hands placed on the upper position of the abdomen, the position of head kept slightly foreword with the support of small towel roll. The eyes may be fully closed, or the upper lids may be dropped and was given 1 minutes of adaptation period. As meditation progress, subjects were asked to undergo 3 minutes for stabilization by Shavasana, Shavasana training the technique recommended by Coulter20 was used. The subject was asked to relax, after this they performed meditation comprising a Pranayam for 4 min while situated as in the control condition (in the supine position with the eyes closed and respiration at a constant frequency of 0.2 Hz in tempo with the sound of a metronome (i.e., 5 breaths/min for 4 min). Then the participants were instructed mindfulness by body scan i.e. focusing attention on various joints by simply focuses on the way each part of body feels without labeling the sensations as either “good” or “bad” in a sequence from the each joint from proximal to distal as described by the expert, once they completes again for 4 minutes Pranayam and finally ended with 3 minutes of Shavasana again. Subsequently, the participants left the room after 20 minutes of session.

CT: This group was given a combination of both music and meditation. Started with posture stabilization done by subjects during 1 minutes of adaptation period, The music was delivered on MP3 player by headphone for 10 minutes of individual choice and after the music session in same supine position meditation training started, they performed meditation comprising all steps as MMT group, but the duration has been reduced to 10 minutes, consists of adaptation period for 1minutes, Shavasana for 1 minutes, Pranayam for 2 minutes, mindfullness for 3 minutes, 2 minutes of Pranayam and finally ended with Shavasana for 1 minute. Subsequently, the participants left the room after 20 minutes of session.

Testing: Subjects were assessed for pre-test and post-test data of salivary cortisol and Performance Score Test.

Salivary Cortisol; For obtaining the free, unbound, biologically active moiety of cortisol, 2 ml. saliva samples were collected by tilting the head forward, allowing the saliva to pool on the floor of the mouth, then passing the saliva through a short straw into a polypropylene vial. The Salivary samples were labeled and sealed and refrigerated in an ice box within 30 minutes and stored samples were stored at –15 °C until the day of assay. Saliva samples were sent to an independent laboratory for cortisol assay. Free cortisol from the samples of saliva was analyzed in the laboratory by using SalimetricsTM SC kit. On day of assay, samples brought at room temperature and thaw completely, and centrifuge at 1500 rpm/g for 15 minutes before adding to assay plate and cortisol was assessed in via enzyme-linked immunosorbent assay as per manufacturer (SalimetricsTM) instructions performed with the biochemist blind to the conditions.

Performance score; calculated by pre-scheduled a competition in an internationally standard shooting range on one day prior to beginning the 1st week, and on 29th day. Shooting accuracy or shooting score was calculated from the standard shooting scoring board and the final result of competition obtained from the chief coach after the completion of competition.

RESULT

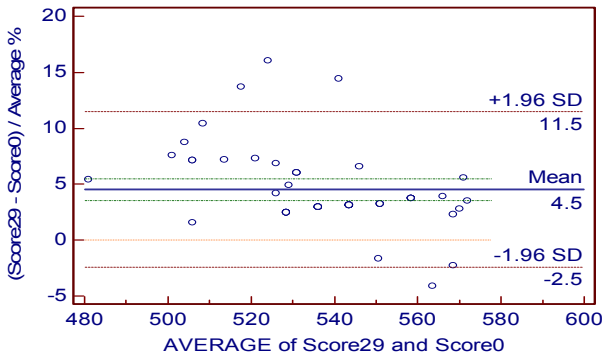
Descriptive statistics (mean and SD) were used to study all outcome variables such as SC and PS (Table-1). The analysis of variance at beginning stage showed non significant difference in the mean values of SC and PS across the 3 study groups ($F= 0.02$; $p = 0.995$), ($F= 0.40$; $p = 0.756$) respectively. But there was highly statistically significant difference in the mean values of SC across the 3 study groups at 29th day ($F= 5.25$; $p <0.0001$). The pair wise comparison of mean values indicates the CT Group subjects mean values of SC were statistically significantly lower at 29th day (0.33) when compared the mean values of study subjects of MT Group at 29th day (0.53), and MMT Group (0.66). There was highly statistically significant difference in the mean values of PS across the 3 study groups at 29th day ($F= 13.69$; $p <0.0001$) (Table-2). The pair wise comparison of mean values indicates the CT Group subjects mean values of PS were statistically significantly higher at 29th day (549.72) when compared the mean values PS of study subjects of MT Group (544.31), and MMT Group (541.69) at 29th day. Whereas among the 3 intervention groups, the mean values of SC in MMT Group were significantly higher than the mean values of MT Group and CT Group and PS in MMT Group were significantly lower than the mean values of MT Group and CT Group (Graph-1).

Table 1. Comparison of mean values of Outcome variables in shooters of study groups

Outcome Variables	M T		MMT		CT	
	Mean	± SD	Mean	± SD	Mean	± SD
SC-Baseline	1.33	.06	1.33	.06	1.33	.15
SC-29th day	.53	.07	.66	.07	.33	.07
PS-Baseline	528	29	528	25	525	26
PS-29th day	544	30	541	25	549	18

Table 2. One way Analysis of Variance Comparison of outcome variables at 2 Stages

Variable	F	Sig.
SC-0 Between Groups	.02	.995
SC-29 Between Groups	5.25	.000
PS- 0 Between Groups	.40	.756
PS 29- Between Groups	13.69	.000



Graph1. Bland and Altman plot—Comparison of pre and post performance values of study subjects who had combination of Music and Meditation as intervention

DISCUSSION

In the current study compared the effect among relaxation therapies by using SC as quantitative physiological marker of HPA- Axis response to stress and PS as a subjective marker for performance outcome. In comparison with all interventional groups, CT group has shown more decrease in SC i.e. 75% (.33), Whereas MT 60% (.53) and MMT 50% (.66) and PS of CT has shown more increase of PS i.e. 4.5% (550) in comparison with MT and MMT groups, 3%(544) and 2.6% (542), respectively (Graph-1). The result of the study showed that an increase in post interventional values in all groups indicated the effectiveness of relaxation therapies, whereas the Combination Therapy was more effective than individual therapies alone.

The reason for higher values at baseline might be supported by studies on competition stress has been observed and supported that, prior to competing sport performers encounter more stressors pertinent to performance. The level of anxiety automatically narrows perception restricting the focus of attention [21, 22, 23]. Thus result of this study indicated that there was an increase in post intervention performance score in all interventional groups; the reason for these changes might be due to decrease in pre competition anxiety.

It is quite possible that SC and chills are simply the best indicators of strong emotional responses. SC has previously been acknowledged as a particularly sensitive measure of strong emotions. For instance, significant increases in SC have been found to accompany exposure to stimuli of high emotional content. Interestingly, since SC is innervated entirely by the sympathetic nervous system, increases in SC appear to be linearly correlated with increases in arousal. Therefore, SC may be regarded as a more pure measure of emotion intensity than other physiological measures [24]. Music affects a reduction in sympathetic nervous control and therefore a reduction in heart and respiration rates, metabolism, oxygen consumption, and muscle tension [25]. Reduced heart and respiration rates lead to less anxiety and can promote relaxation. Studies also supported by reductions in autonomic activity and self-reported tension and improved performance of surgeons [26]. In students engaged in stressful tasks, lower salivary cortisol levels are noted in those listening to music compared with control subjects, whose cortisol levels increased [27].Although there are wide individual and cultural variations in types of music preferred, certain kinds of music appear to have consistent physiologic effects [28]. Current study given MT based on self selection and classical music. It has direct and indirect effects on physiology and stress symptoms. Carefully selected music can reduce stress, enhance a sense of comfort and relaxation, offer distraction from pain, and enhance sports performance. These factors might have supported the more result in groups involved with music.

As repeated listening to music affects people's preference for it as well as their physiological responses to it [29], In our study we have given 20 minutes session for 4 weeks this could have supported the more effect of music therapy in frequency components than meditation.

Study supported by participants who meditated had

better attention processing on alerting function as well as better mood, lower cortisol, and better immune function, allowing to conclude that randomly assigned short-term intensive meditation causes immediate benefits [30].

A study on hypertension demonstrated that reductions in both systolic and diastolic blood pressure as a result of participating in a daily meditation program, and the magnitudes of these changes were approximately twice that seen in progressive muscle relaxation [31]. Changes that might have been expected to occur on the MMT based on the physiology of meditation would include those associated with decreased sympathetic nervous system arousal, such as decreases in the cardiopulmonary symptoms of rapid respiration and heart rate, decreased muscle tension and fewer gastrointestinal symptoms [32,33].

Music listening may influence cognitive functioning via alternate pathways by helping to better organize cortical brain transmissions [34]. Researchers found low concentrations of the blood levels of cortisol in TM practitioners, in comparison with nonpracticing subjects [35]. The addition of MT, a meditative component may also enhance the effectiveness of the programs in CT groups in PCS symptoms. Our study seems to indicate that the CT program is most effective at improving cognitive-based symptoms of stress by decreasing SC level, although we did also see improvements of PS.

Major objectives of the relaxation therapies include increasing the individual's awareness of their propensity to analyze, evaluate, and project into the future and to shift attention to direct and immediate perception of ongoing experience. It is possible that more highly trained elite shooters, who may theoretically be presumed to use intellectualizing coping methods preferentially, may benefit the most in terms of stress reduction by learning to apply this new way of moving through the world.

CONCLUSION

The past empirical evidence has lent support to the view that psychophysiological recordings may even provide insight into the skill related aspects of a shooter's psychomotor strategies and determinants of successful shooting performance. It is also shown comparatively music is better than meditation alone group in one month duration training. As previous studies the long term training may enhance the further in each group.

REFERENCES

1. Terry PC, Slade A. Discriminate effectiveness of psychological state measures in predicting performance outcome in karate competition. Perceptual and Motor Skills. 1995; 81(1): 275-286.
2. Stephen DM, Richard N, Sheldon H, David F. Competition stress in sport performers: Stressors experienced in the competition environment. Psychology of sport and exercise. 2009; 27(7): 729-736.
3. Chamberlain ST, Hale BD. Competitive state anxiety and self-confidence: Intensity and direction as relative predictors of performance on a golf putting task. Anxiety, Stress, and Coping. 2007; 20: 197-207.
4. Kais K, Raudsepp L. Intensity and direction of competitive state anxiety, self-confidence and athletic performance. Kinesiology. 2005; 37: 13-20.
5. Swain A, Jones G. Explaining performance variance: The relative contribution of intensity and direction dimensions of competitive state anxiety. Anxiety, Stress, and Coping. 1996; 9: 1-18.
6. Maddan, Summers, Brown. Coping behavior and susceptibility to chocking. Journal of Sports Behavior. 2004; 2: 7-23.
7. Cohn PJ. An exploratory study on sources of stress and athlete burnout in youth golf. The Sport Psychologist. 1990; 4(2): 95–106.
8. Gould, Eklund, Jackson. U.S. Olympic wrestling excellence: I. mental preparation, precompetitive cognition and affect. The Sport Psychologist. 1988; 6(4): 358 - 382.
9. Craft LL, Magyar M, Beaker BJ, Feltz DL. The relationship between the Competitive State Anxiety Inventory-2 and sport performance: A meta-analysis. Journal of Sport and Exercise Psychology. 2003; 25: 44-65.
10. Solberg EE, Bergulund KA. The effect of meditation on shooting performance. British Journal of Sports Medicine. 1996; 30: 342-346.
11. Mesagno C, Marchant D, Morris T. A pre-performance routine to alleviate choking in 'Choking-Susceptible' athletes. The Sport Psychologist. 2008; 22 (4): 439-457.
12. Vlachopoulos SP, Karageorghis CI, Terry PC. Motivation profiles in sport: A self-determination theory perspective. Research Quarterly for Exercise and Sport. 2000; 71: 387-397.
13. Karageorghis CI, Drew KM, Terry PC. Effects of pretest stimulative and sedative music on grip strength. Perceptual and Motor Skills. 1996; 83: 1347–52.
14. Astin JA. Stress reduction through mindfulness meditation: Effects on psychological symtomatology, sense of control and spiritual expe-riences. Psychotherapy and Psychosomatics. 1997; 66(2): 97-106.
15. Chiesa A, Serretti A. A systematic review of neurobiological and clinical features of mindfulness meditations. Psychological Medicine. 2010; 40: 1239-52.
16. Chambers R, Lo BCY, Allen NB. The impact of intensive Mindfulness training on attentional control, cognitive

style and affect. Cognitive Therapy and Research. 2008; 32: 303-22.

17. Solberg EE, Ingjer F, Holen A. Reviews of the literature, Recovery from a standardized exercise bout: a study on 31 runners practicing relaxation technique. British Journal of Sports Medicine. 2000; 34: 268-272.
18. Mononen K, Konttinen N, Viitasalo J, Era P. Relationships between postural balance, rifle stability and shooting accuracy among novice rifle shooters. Scand J Med Sci Sports. 2007; 17: 180–85.
19. Tremayne P, Barry RJ. Elite pistol shooters: Physiological patterning of best vs. worst shots. International Journal of Psychophysiology. 2001; 41: 19–29
20. Coulter HD. (Eds.), Relaxation and meditation. In: Anatomy of Hatha Yoga: Body and Breath, first ed. Inc. Honesdale; 2001. p. 547–557.
21. Curry DG, Meyer JE, McKnney JM. Seeing versus perceiving: What you see isn't always what you get. Professional Safety. 2006; 57(6): 28-34.
22. Fredrickson BL, Branigan C. Positive emotions broaden the scope of attention and thought-action repertoires. Cognition and Emotion. 2005; 19(3): 313-332.
23. Most SB, Scholl BJ, Clifford ER, Simons DJ. What you see is what you set: Sustained in attentional blindness and the capture of awareness. Psychological Review. 2005; 112(1): 217-242.
24. Mahwah NJ: Erlbaum (4th Eds.) Psychophysiology: Human Behaviour and Physiological Response, Andreassi JL; 2000. p. 415-19.
25. Lee OK, Chung YF, Chan MF, Chan WM. Music and its effect on physiological and anxiety levels of patients receiving mechanical ventilation: a pilot study. Journal of Clinical Nursing. 2005; 14(5): 609-620.
26. Allen K, Blascovich J. Effects of music on cardiovascular reactivity among surgeons. JAMA. 1994; 272: 882-884.
27. Khalfa S, Bella SD, Roy M, et al. Effects of relaxing music on salivary cortisol level after psychological stress. Ann N Y Acad Sci 2003; 999:374–376.
28. McCraty R, Barrios Choplin B, Atkinson M, et al. The effects of different types of music on mood, tension, and mental clarity. Altern Ther Health Med 1998; 4: 75– 84.
29. Knight WEJ, Rickard NS. Relaxing music prevents stress-induced increases in subjective anxiety, systolic blood pressure and heart rate in healthy males and females. Journal of Music Therapy. 2001; 38: 254-272.
30. Tang Y, Ma Y, Wang J, Feng S, Yu Q, Rothbart MK, et al. Short-term meditation training improves attention and self- regulation. PNAS Proceedings of the National Academy of Sciences of the United States of America. 2007; 104: 17152–56.
31. Schneider RH, Staggers F, Alexander CN, et al. A randomized controlled trial of stress reduction for hypertension in older African Americans. Hypertension. 1995; 26: 820–827
32. Jevning R, Wallace RK, Beidebach M. The physiology of meditation: a review. A wakeful hypometabolic integrated response. Neurosci Biobehav Rev. 1992; 16: 415–424
33. Sudsuang R, Chentanez V, Veluvan K. Effect of Buddhist meditation on serum cortisol and total protein levels, blood pressure, pulse rate, lung volume and reaction time. Physiol Behav. 1991; 50: 543–548
34. Rauscher FH., Shaw GL., Ky KN. Music and spatial task performance. Nature. 1993; 365:611.
35. Walton KG., Pugh ND, Gelderloos P. Macrae P. Stress reduction and preventing hypertension: preliminary support for a psychoneuroendocrine mechanism. Journal of Alternative Complementary Therapy. 1995; 1: 263-283.