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Effect of music therapy, aerobic exercise and combined intervention on psychological and physiological parameters in collegiate athletes: A comparative study

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Abstract

Purpose: Aim of the study is to compare the effect of three forms of interventions: relaxing music, aerobic exercise, and both in combination, on state and trait anxiety, RPE and HR in collegiate athletes.
Subject: Thirty five collegiate athletes were recruited with inclusion and exclusion criteria and randomly allocated into one of the three groups.
Methodology: Each group were performed with different interventions, Group 1- music therapy, group 2- aerobic exercise, group 3- music with aerobic exercise. The intervention was performed one session per day for two weeks. Pre and post measurement of STAI-Y1 Score, STAI-Y2 Score, RPE and HR were taken.
Data analysis: ANCOVA and repeated measure analysis were used to analyze the changes in the psychological and physiological parameters.
Result: Music therapy, aerobic exercise and combination therapy shows significant changes in pre and post value of STAI-Y1, STAI-Y2, RPE and HR while combination therapy was more effectively reduced state anxiety and trait anxiety when compared individual therapy. There was a significant group × time effect for STAI-Y1 score (p=0.012), STAI-Y2 score (p=0.001) and HR (p=0.016).
Conclusion: So the study revealed that while music therapy and aerobic exercise, when imparted independently, both reduce the state and trait anxiety level in collegiate athletes, the magnitude of reduction increases if combined intervention is used.

Keywords: State anxiety, Trait anxiety HR, RPE, music plus aerobic exercise.

Introduction

There are various psychological and autonomic factors that affect the athletic performance. In sports, there is a tendency to increase the level of anxiety in athletes (Bull, 2000). Various researchers have shown their interest in the importance of anxiety on performance. According to Raglin and Hanin (2000), anxiety is one of the psychological factors that have a great influence on performance. Researches showed that winning in a competition and performance of athlete

depends upon how athletes control their anxiety levels (Humara, 2001). However, the problem among athletes arises when they failed in controlling their anxiety (Cox, Qiu and Liu, 1993; Bull, 2000). Heart rate is the one physiological parameter that affect performance of an athlete. Heart rate for a trained athlete increase at smaller rate than a sedentary person to meet maximal oxygen demand (McArdle, Katchand Katch, 2006). It is established that higher level of performance can be achieved if athlete trained to keep resting heart rate at lower level (Achten & Jeukendrup, 2003). Apart from lower resting heart rate athletes rate of perceived exertion (RPE) is another factor that also affect the athletic performance. To achieve higher level of performance athletes trained to keep RPE at the lower side.

Anxiety is defined by Anshel et al., (1991) as "a subjective feeling of apprehension or perceived threat, sometimes accompanied by heightened physiological arousal". This state results when an individual doubts his or her ability to cope with a situation, which leads to stress (Jurko, 2013).In 1966, Spielberger defined trait anxiety as an individual's predisposition to respond, and state anxiety as anemotion characterized by physiological arousal and consciously perceived feelings of apprehension, dread and tension. State anxiety assesses how an individual feels at a particular moment and trait anxiety assesses how the individual usually feels.

Physical activities and exercise not only improve physical capacities and health, but also enhance psychological well-being (ACSM, 2006). Previous literature suggests that physical activity has great influence on psychological states like anxiety and depression (Petruzzello et al., 1991, De Moor et al., 2006 and Ströhle, 2009). The positive correlation between exercise and acute mood state benefits has been well established (Yeung, 1996 and Rokka et al., 2010). Studies suggest that aerobic exercise yields significant reduction in self-reported anxiety sensitivity (Broman-Fulks et al., 2004, 2008). Hale et al., (2002) reported that aerobic exercise has greater influence in reducing state anxiety than any other form of exercise. It was seen in our previous study that aerobic exercise is beneficial in reduction of anxiety level in collegiate athletes (Jamali et al., 2015).

Music therapy is defined as "a behavioural science that applies music and musical interventions systematically, to restore, maintain and improve emotional, physiological and spiritual health and well-being" (Jing & Xudong, 2008). Music positively influences health and well-being, reducing the feeling of stress (MacDonald, 2013 and Laukka, 2007). Music therapy used as a relaxation aids (Krout, 2001; Curtis, 1986) within the medical environment and Music helps fasten post exercise recovery (Savitha et al., 2010), while the effectiveness of music in cardiac care unit in order to reduce stress and anxiety in cardiac patients has been established (Bhana et al., 2014 and Bradt et al., 2009). Music therapy has also shown effect on the anxiety in palliative care unit (Calovini, 1993; Gallagher, 2001). Lesser studies had been done on the athletic population.

Combination of music with exercise produces enormous physical and psychological benefits (Macone et al., 2006, Karageorghis et al., 1997 and Baldari et al., 2010). Listening to music during exercise can produce an ergogenic effect by improving exercise performance (Bacon et al., 2012 and Simpson et al., 2006). Music decreases rating of rate of perceived exertion (RPE) during exercise at moderate intensity (Szmedra et al., 1998) on the other hand (Schwartz et al., 1990) found that RPE did not differ regardless of the presence or absence of music at 75% VO_2 max furthermore (Nethery 2002) reported that RPE decreases while listening to music during exercise at 50% VO_2 but not at 80% VO_2 max .Thus, music influences RPE during exercise at low but not at high intensity. Another study has uncovered a high correlation between RPE and HR. (Borg GA et al., 1982). However (Copeland et al., 1991) reported that HR when listening to soft slow music during exercise becomes low compared to when listening to loud/upbeat music-on the other hand (Schwartz et al., 1990) has suggested that there is no difference in HR. Whatever music is

listening to, thus there is no consistent view regarding the effect of listening to music on HR during exercise. Although effect of listening to a music on RPE during exercise are affected by exercise intensity.

Therefore, the aimed of present study is to determine and compare the effect of three forms of interventions, i.e., relaxing music, aerobic exercise, and music along with aerobic exercise, on state and trait anxiety, RPE and HR, in collegiate athletic population.

Methods

Participants

Thirty five collegiate athletes from Jamia Millia Islamia and nearby colleges, New Delhi, India were recruited for the study (Mean ± SD for age 20.94 ± 1.86 years, height 164.02± 9.28 cm, weight 56.59±6.86 kg and BMI 21.03 ± 1.92). Ethical clearance was obtained from Institutional Ethical Committee.

Sample

Total Sample of 35 were randomly divided into three groups: music therapy group (group 1) (N=11), aerobic exercise group (group 2) (N=12) or music with aerobic exercise /combined intervention group (group 3) (N=12).

Inclusion Criteria

Age = 18-30 years, Both male and females, BMI 19 – 24.9 kg/msq, fulfilling pre participation screening criteria to start physical activity, PAR Q (Church T 2006), previous experience of treadmill running, no injury in last six months, no auditory impairment.

Exclusion Criteria

Involvement in any type of psychotherapy, use of psychiatric medicines, any health condition that would preclude aerobic exercise.

Research Design

Pre - post experimental design with randomized allocation of subjects into three different interventional groups.

State trait anxiety inventory for adults

The present study used state trait anxiety inventory for adults (STAI) (Spielberger, 1983, 1976), to measure participant's anxiety levels. STAI represents different anxiety symptoms, which the participants rate on a 4-point Likert scale have gone through the test construction and process of validation (Spielberger & Gorsuch, 1966 and Spielberger et al., 1970).Both of the scales i.e. STAI-Y1 and Y2 (State Anxiety and Trait Anxiety) are printed on opposite sides of a single page test form.

State trait anxiety inventory for state anxiety (STAI-Y1)

The state anxiety scale (STAI Form Y-1) consists of twenty statements that seek to evaluate how the respondent feels at a specific moment. In responding the scale, examinees blacken that number on the standard test form, to the right of each item statement,that best describes the intensity of their feelings: (1) not at all; (2) somewhat; (3) moderately so; or (4) very much so.

State trait anxiety inventory for trait anxiety (STAI-Y2)

The trait anxiety scale (STAI Form Y2) consists of twenty statements that assess how the individual generally feels. In responding to the trait anxiety scale, examinees were instructed to indicate how they generally feel, on the following 4-point scale: (1) almost never; (2) sometimes; (3) often; or (4) almost always.

Procedure

Subjects fulfilling inclusion and exclusion criteria were selected for the study, and randomly allocated into one of the three groups i.e. music therapy group (group 1), aerobic exercise group (group 2) or music with aerobic exercise /combined intervention group (group 3). Prior to participation, all subject's informed consent were obtained. A number was assigned to each subject to keep information confidential. Stadiometer and digital weighing machine were used to measure

height and weight, respectively. Physical Activity Readiness Questionnaire (PAR-Q) was established for pre participation screening**.**

Subjects in group 1 received music therapy**,** which was instrumental Indian classical music, in a relaxed seated position in a calm and distraction-free environment. Time duration for each session was 20 minutes. Intensity (volume of the music) was selected by the subject (Baldari et al., 2010). Subjects of group 2 performed 20 minutes aerobic exercise on a treadmill in each session. Subjects of group 3 received music therapy through iPod or any other portable listening device via head phones, while also performing aerobic exercise on a treadmill for 20 minutes, in each session (Broman-Fulks et al., 2004). The interventions were provided for two weeks i.e. fourteen days (one session per day) for all the three groups. STAI, RPE and HR measurements were taken before and after the completion of two weeks of intervention.

Music Selection

In the present study, to nullify the possible response bias due to selection of music, relaxing music was selected by the examiner. Instrumental Indian classical music was selected for anxiety control as per recommendations of Elliott et al., (2011). For example, tempi ranged between 80 and 100 beats per minute, rhythms were relatively subtle, simple and constant, melodies were strong and secure, and harmonies were consonant. The music was transferred to iPod or other portable listening device, and played through headphones. Subjects were allowed to regulate the intensity (volume) according to their comfort (Baldari et al., 2010).

Aerobic Exercise Protocol

Participants of exercising completed 20-minute aerobic exercise sessions daily over a 2-week period. Each participants were fitted with a Polar heart rate monitor and RPE scale of Borg's was displayed to them to rate their exertion during exercise. As recommended by American College of Sports Medicine (2006) for aerobic activity, exercise participants were instructed to briskly walk or jog on a treadmill, at a speed that maintained their heart rate between 60-70% of their predicted maximum heart rate, for 20-minuteSs in each session. Heart rate range of each participant was calculated manually. Heart rate was monitored by the experimenter at every 2 minute intervals, and RPE was scored every 3-minute interval. aerobic heart rates were maintained by adjusting speed of treadmill. While exercising, participants were not allowed to engage in any other activities (e.g., talking, eating, singing), to minimize distractions from arousal sensations (Broman-Fulks et al., 2008).

Data Analysis

The SPSS Version 21.0 was used for the data analyses. Results are reported for each group in mean and standard deviation (SD). One way ANOVA is used to analyze the difference in the demographic characteristics and pre-intervention score for the STAI-Y1, STAI-Y2, RPE and HR. Repeated measure analysis was done for analysis pre intervention and post intervention scores within groups. ANCOVA was used to analyze the difference between all three groups, with Pre-intervention score as a covariate and group as a factor to find out the main effect and group × time effect. Post hoc Bonferroni pairwise comparison used for obtaining a significant difference between the groups. A p value less than 0.05 were considered as a statistically significant value.

Results

There is no significant difference shows for the demographic characteristics between the groups. The mean (standard deviation) of age, height, and weight and BMI are given in Table 1. One way ANOVA revealed no significant differences between the three groups at baseline for STAI-Y1 (p=0.42) and STAI-Y2 (p=0.232) while RPE (p<0.001) and HR (p<0.001) shows significance difference in pre-intervention values. The mean (standard deviation) of pre-value and post value for all groups are reported in Table 4. Repeated measures analysis shows significant difference in the pre-intervention and post-intervention for STAI-Y1, STAI-Y2, RPE and HR with a moderate to high effect size (partial Eta-squared value) in all three groups (Table 2).

Table 1: Comparison of Demographic Data between Groups

Variable	Group 1 Mean (SD) N=11	Group 2 Mean (SD) N=12	Group 3 Mean (SD) N=12	*F* value	*p*-value
Age (yrs)	21.36(1.43)	21.08(2.23)	20.42(1.83)	0.784	0.465
Sex					
Male(n/%)	5(45.5)	6(50)	6(50)		
Female (n/%)	6(54.5)	6(50)	6(50)		
Height (cm)	163(8.88)	166.5(8.69)	162.5(10.44)	0.641	0.698
Weight (kg)	56.31(8.15)	57.91(5.8)	55.52(6.93)	0.363	0.533
BMI (W/H^2)	21.10(1.43)	20.94(2.16)	21.05(2.21)	0.020	0.980

Group 1: music therapy group; group 2: aerobic exercise group; group 3: music with aerobic group; BMI: body mass index; W: weight; H: height; SD: Standard deviation; significant difference: $p<0.05$

Table 2: Comparison of variables pre and post intervention within group 1, 2 and 3.

Groups	Variables	Pre values Mean(SD)	Post Values Mean(SD)	F value	*p*-value	Partial eta square
Group 1	STAI-Y1	48.45(4.86)	39.45(6.44)	65.515	<0.001	.868
	STAI-Y2	45(5.76)	40.36(5.81)	14.914	0.003	.599
	RPE	7.09(0.83)	6.27(4.88)	9.643	0.011	.491
	HR	67.45(5.14)	62.36(1.47)	105.94	<0.001	.914
Group 2	STAI-Y1	51.83(3.81)	39.42(6.33)	48.81	<0.001	.816
	STAI-Y2	41(7.07)	37.67(5.92)	20.75	0.001	.654
	RPE	12.58(1.5)	7.92(1.37)	116.54	<0.001	.914
	HR	123.25(2.52)	117.25(1.76)	49.50	<0.001	.818
Group 3	STAI-Y1	52.08(10.75)	31.83(3.63)	41.43	<0.001	.790
	STAI-Y2	45.33(7.15)	34.25(3.41)	24.83	<0.001	.693
	RPE	12.75(1.21)	8.50(.905)	130.64	<0.001	.992
	HR	123.17(2.48)	113(3.21)	86.53	<0.001	.887

Group 1: music therapy group; group 2: aerobic exercise group; group 3: music with aerobic group, STAI-Y1: state trait anxiety inventory for state anxiety; STAI-Y2: state trait anxiety inventory for trait anxiety; RPE: Rate of perceived exertion; HR: Heart rate; SD: Standard deviation; significant difference: $p<0.05$

In between group comparison there was a significant group × time effect for STAI-Y1 score (p=0.012), STAI-Y2 score (p=0.001) and HR (p=0.016) with low effect size (partial eta-square <0.379) while non significant group × time effect for RPE (p=0.665) (Table 3). Similarly the STAI-Y1 score (p=0.046), STAI-Y2 score (p=0.007) and HR (p=0.004) showed significant difference between the groups (main effects), while RPE value showed no significant difference between the groups (main effects) (p=0.628) (Table 3).

Table 3: Comparison between the groups

Variable	Comparison between groups	F value	P value	Partial eta square
STAI-Y1	Group (main effect)	3.443	0.046	0.192
	Group*time (interaction)	5.17	0.012	0.263
STAI-Y2	Group (main effect)	5.878	0.007	0.288
	Group*time (interaction)	8.849	0.001	0.379
RPE	Group (main effect)	.473	0.628	0.032
	Group*time (interaction)	.413	0.665	0.028
HR	Group (main effect)	6.621	0.004	0.313
	Group*time (interaction)	4.76	0.016	0.247

STAI-Y1: state trait anxiety inventory for state anxiety; STAI-Y2: state trait anxiety inventory for trait anxiety; RPE: Rate of perceived exertion; HR: Heart rate

Result of post hoc bonferroni pairwise comparison after analysis of covariance suggested that the STAI-Y1 in group 3 were significantly different as compared with group 1 ($p< 0.001$) and group 2 ($p=0.004$). Furthermore, in terms of STAI-Y2 same relation is shows significant difference of group 3 with group 1 ($p =0.003$) and group 2 ($p=0.001$). For RPE values no significant difference between all three groups. Also HR values shows no significant difference between all three groups but difference between group 2 with group 1 was very near ($p =0.052$) (Table 4).

Table 4: Descriptive statistics of variables pre and post values between group 1, 2 and 3

Variable	Group 1 Mean (SD)	Group 2 Mean (SD)	Group 3 Mean (SD)
STAI-Y1 Pre	48.45 (4.86)	51.83(3.81)	52.08 (10.75)
STAI-Y1 Post	39.45 (6.44)	39.42(6.33)	31.83 (3.63)^#
STAI-Y2Pre	45 (5.76)	41(7.07)	45.33(7.15)
STAI-Y2 Post	40.36 (5.81)	37.62 (5.92)	34.25 (3.41)^#
RPE Pre	7.09 (0.83)	12.58 (1.5)	12.75(1.21)
RPE Post	6.27(0.46)	7.92(1.37)	8.5(0.905)
HR Pre	67.45(5.14)	123.25 (2.52)	123.17(2.48)
HR Post	62.36(4.88)	117.25(1.76)	113(3.21)

Group 1: music therapy group; group 2: aerobic exercise group; group 3: music with aerobic group; STAI-Y1: state trait anxiety inventory for state anxiety; STAI-Y2: state trait anxiety inventory for trait anxiety; RPE: Rate of perceived exertion; HR: Heart rate

Discussion

As far as music therapy is concerned, researches have shown that music as a relaxation aid is also used extensively within receptive music therapy (Grocke & Wigram, 2007). The present study supports the various literatures that have investigated the anxiolytic effects of music, generally conducted within medical environment. Bhana et al. (2014) reported that therapeutic use of music is highly beneficial to ICU patients who have had cardiac surgery, and that together with routine postoperative care, it can promote holistic patient care. Nilsson (2008) conducted a systemic review to check the anxiety and pain reducing effects of musical intervention in surgical, pre-operative and post-operative patients, and concluded that music therapy reduces pain and anxiety in hospital settings. It has also been stated that music reduces stress and anxiety in coronary heart diseases (Bradt et al., 2009), and promotes mental health and well-being among the community (MacDonald, 2013). The results of the present study are consistent with previous findings, and support the fact that music therapy exhibits the Anxiolytic effect.

The present study revealed that aerobic exercise is a good tool for reducing state and trait anxiety levels. It supports findings of the review by Petruzzello et al., (1991) that anxiety reduction occurred following aerobic exercise training. Aerobic exercise highly affects the mood status of an individual and ultimately reduces the stress level (Ströhle et al., 2009, Yeung et al., 1996 and Rokka et al., 2010). Results of this study were also in line with a previous study which concluded that aerobic exercise is beneficial for reducing anxiety in collegiate athletes (Jamali et al., 2015). A variety of mechanisms, ranging from simple distraction to changes in brain neurochemistry to psychological changes associated with exercise, are accepted for the effects of aerobic exercise on anxiety reduction (Hale et al., 2002).

Considering the effect of combined intervention on state and trait anxiety, this study revealed that collegiate athletes exhibit a more pronounced reduction in their anxiety level, after sessions of aerobic exercise in the presence of music, as compared to independent music therapy or aerobic exercise sessions. The results support the findings of Baldari et al., (2010), who reported that exercising while also getting music therapy reduces anxiety at a greater extent than exercising without music in active participants. The results were in contrast with Macone et al., (2006) who reported that exercising along with musical intervention does not result in reduction of state anxiety; and consistent with the findings of Fritz et al., (2013) who reported that exercising while getting musical feedback enhances the mood status of an individual, and ultimately reduces anxiety. This discrepancy could partly be due to population difference. One of the major findings of the review by Karageorghis et al., (2012) was that when exercise is performed at low to moderate intensity along with music, an ergogenic effect is produced, promoting mental health and well-being. The present study contradicts the study done by Dave Elliott et al., (2014) which reported that relaxing music for anxiety control is no more effective at reducing anxiety than non-relaxing music or a period of silence. This may arise because aerobic exercise is also being used along with music therapy moreover in their study anxiety was induced to the subject but in present study normal (natural) anxiety level of subjects were investigated. Although various mechanisms have been proposed as to how music therapy and aerobic exercise reduce anxiety, they are still not well understood. Music, in combination with exercise, systematically increases psychological arousal. In terms of mechanism of music therapy, some theories suggest that music is a kind of energy, and can make viscera, muscle and brain waves vibrate rhythmically, following the tempo speed and melody of music (Jing et al., 2008). Exercising with music may increase cognition provocation via generating motivation (RamezanPour et al., 2012). The application of music therapy and aerobic exercise for anxiety reduction is still supposed to be similar to the process proposed in previous literature. It has been proposed that when the body temperature increases during aerobic exercise, it reduces muscle tension and level of anxiety. Moreover, music adds on to the anxiolytic effect of exercise. It is thought that the limited capacity of our nervous system is relevant to the effect that music has on anxiety. The afferent nervous system transmits sensory impulses towards the central nervous system (brain and spinal cord), which has limited capacity, and sensory stimuli such as music can impede the physiological feedback signals associated with anxiety. At very high intensity levels, physiological cues appear to dominate processing capacity due to their relative strength, while at more moderate intensity levels of exercise, both internal (e.g. kinaesthetic) and external (e.g. music) cues can be processed parallelly (Karageorghis and Priest, 2012).

In this study rating of perceived exertion and heart rate shows equal change in both groups after training, previous study suggest that introduction of music has a psychobiological impact on the exerciser demonstrate changes in RPE and heart rate (Szmedra et al.,1998 Yamashita et al., 2006). Music might allow participants to relax and reduce muscle tension, thereby increasing blood flow and lactate clearance while decreasing lactate production in the working muscles and consequently having a psychobiological impact on exercise. During exercise Music may influence emotions and mask unpleasant feelings. In a study

it is suggested that music along with exercise in athletes can promote two chronic benefits: increased exercise adherence and more effect pre-event routine for athletes. (V.M Nethery in 2002) assess the effectiveness and psychophysical responses to motivational music during treadmill running at 50% VO2 max using RPE, affect, heart rate and post-exercise mood as dependent measures. It was reported by Mohammadzadeh et al., (2008) that when exercise is done along with musical intervention, RPE reduced. Combined intervention helps in relaxation by reducing heart rate (RamezanPour et al., 2012), and therefore has a positive effect in terms of performance, as well as psychological state of athletes. Combined intervention is also beneficial for cardiovascular rehabilitation, central, musculoskeletal and psychological fatigue (Jing et al., 2008). Exercising, along with music, help to regulate physiological parameters of anxiety and psychological fatigue at a faster rate, than relative rest or individual treatment, resulting in lower anxiety.

As far as limitations of the study are concerned, various other external, internal and social factors can influence these psychological and physiological parameters in athletes that can affect the results, have not been taken into account. Use of only a subjective parameter for anxiety assessment can be a limitation. Moreover, the present study considers anxiety as debilitative, but it can be facilitative for some athletes. In terms of future prospective, the study can be implicated to more ecological valid environments, with use of objective anxiety measures like muscle tension, cardiovascular measurement or alteration in central nervous system. Subjects from a specific sport can be studied. Anxiety response to different types of music and different forms of exercises can also be investigated.

Conclusion

So it is concluded from the present study that both music therapy and aerobic exercise result in reduction of state and trait anxiety ,HR and RPE level in collegiate athletes, but a combination of these two interventions, i.e., music and aerobic exercise, brings about a greater effect than either type of intervention alone. By the help of music an athlete can get rid of excessive fatigue while exercise hence it can be helpful in making them do exercise for longer period of time. Therefore, athletes who wish to regulate their anxiety and promote exercise adherence through physical activity should be encouraged to perform aerobic exercise along with music therapy.

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