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Original Article

Physiology Section

Beneficial Effect of Preferential Music on Exercise Induced Changes in Heart Rate Variability

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ABSTRACT

Introduction: Music is known to reduce pain, anxiety and fear in several stressful conditions in both males and females. Further, listening to preferred music enhances the endurance during running performance of women rather than listening to non-preferred music. In recent years Heart Rate Variability (HRV) has been used as an indicator of autonomic nervous activity.

Aim: This study was aimed to assess the effectiveness of preferential music on HRV after moderate exercise.

Materials and Methods: This was an experimental study done in 30 healthy students aged between 20-25 years, of either sex. HRV was measured at rest, 15 minutes of exercise only and 15 minutes of exercise with listening preferential music in same participants. Data was analysed by One-Way ANOVA and Tukey HSD Post-hoc Test. Statistical significance was taken to be a p-value of less than 0.05.

Results: Low frequency and high frequency component was significantly increased followed by only exercise. Music minimized increase in both high and low frequency component followed by exercise. However, only high frequency change was statistically significant. LF/HF ratio was significantly increased followed by only exercise. Music significantly minimized increase in LF/HF ratio.

Conclusion: This study provides the preliminary evidence that listening to preferential music could be an effective method of relaxation, as indicated by a shift of the autonomic balance towards the parasympathetic activity among medical students.

Keywords: Autonomic functions, Music therapy, Sympathetic and parasympathetic activity, Medical students

INTRODUCTION

The practice of using music in healing can be traced back to ancient African, Indian, Hebrew, Chinese and Roman civilizations [1,2]. Music has been shown to have a positive effect on a variety of physical, psychological and behavioural aspects of human existence [3]. Music was used to enhance motor coordination, improve muscular and joint strength, increase muscular tone and endurance, induce relaxation, and improves balance and posture, aid locomotion and the development of neuromotor patterns [4,5]. Various studies have reported conflicting results with respect to the heart rate changes in response to music [6]. While submaximal treadmill exercise heart rate and plasma lactate were effectively controlled in music group [7]. This may be due to failure to control variables associated with fluctuations in heart rate or unsuccessful matching of musical stimuli to beat patterns [8]. In recent years Heart Rate Variability (HRV) has been used as an indicator of autonomic nervous activity [9]. In frequency analysis of heart rate variation, the frequency is divided into a low frequency component (LF; 0.04–0.15 Hz) and a high frequency component (HF; 0.15–0.40Hz). The ratio of the low and high frequency components (LF/HF) can then be determined to obtain a relative indicator of parasympathetic activity and sympathetic activity [10]. Both sympathetic and parasympathetic components are involved in the LF component, whereas the HF component shows stimulation of parasympathetic nervous system [9]. An increase in LF/HF is therefore believed to be an indicator of increased sympathetic nervous system activity [11].

Music is known to reduce pain, anxiety and fear in several stressful conditions in both males and females [12,13]. Earlier studies reported that individualizing the type of music used is vital to success of music therapy with studies showing that the degree of liking the music was the most important factor in relaxation [14]. According to Wininger et al., the enjoyment of exercise is an influential factor in the rate of recovery and adherence to an exercise program [15]. It is evident from the analysis of these studies on exercise capacity that more in depth research is needed. This study was aimed to assess the effectiveness of soothing music on heart rate variability after moderate exercise.

MATERIALS AND METHODS

The present study was an experimental study conducted during 2013-2014. The study was approved by Institutional Ethics Committee. A written, informed consent was obtained from all the participants. The study was performed in accordance with the "Ethical Guidelines for Biomedical Research on Human Participants, 2006" by the Indian Council of Medical Research and the Declaration of Helsinki, 2008.

Participants

The study population comprised of students of Saveetha University, situated in Chennai, Tamil Nadu, India. A total of 30 healthy male and female volunteers (18 male and 12 female), between the ages of 20 and 25 years, participated in the study. Participants were selected by simple random sampling by using random numbers generated by computer. A detailed clinical examination was done on all subjects.

Students with previous history of cardio respiratory disease, epilepsy, recent injury or immobilization, mentally challenged, physically challenged, spinal deformity, infective diseases and muscle disease were excluded from the study.

Procedure

After recording base line ECG, the participants were asked to perform moderate exercise [16] in bicycle ergometer for 15 minutes, without music and ECG was recorded. Then the participants were asked to perform moderate exercise for 15 minutes with the music in bicycle ergometer and ECG was recorded. Rest given between the two sessions was 30 minutes [16].

Recording of Heart Rate Variability (HRV)

HRV represents one of the most promising markers and is a simple tool for both research and clinical studies. HRV has become the conveniently accepted term to describe instantaneous heart rate and RR interval. The clinical importance of HRV was appreciated in the late 1980's when it was confirmed the HRV was a strong and independent predictor of mortality after an acute myocardial infarction [17]. HRV was measured using the digital physiograph in the Department Physiology of Saveetha Medical College. HRV was recorded according to the recommendations of the Task force on HRV [17]. For short term recording of HRV, according to the task force, spectral analysis of HRV is more reliable than the time domain analysis [18].

Frequency Domain Method

Power Spectral Density (PSD) analysis provide the basic information of how the power (variance) distributes as a function of frequency. PSD is generally classified as parametric and non parametric [19].

Short Term Recordings

Three main spectral components were calculated from short term recordings of 5 minutes VLF, LF and HF components. The distribution of power and the central frequency of LF and HF are not fixed but may vary in relation to autonomic modulations of heart period. The measurement of VLF, LF and HF power components is usually made in absolute values of power (millisecond squared) LF and HF may also be measured in normalized units. Low Frequency (LF): (.04 Hz–.15 Hz) indicates sympathetic activity and High Frequency (HF): (.15 Hz–.40 Hz) indicates parasympathetic activity.

Selection and Administration of Music

Music intervention was selected by following principles of International Organization For Standardization (ISO) [20]. Tamil movie songs based on carnatic ragas was selected on basis of slow jathi – rupukam 3 beats / cycle, slow thalam – Tisram 3 pulses / per beat for soothing music. Four samples of the soothing music was selected in consultation with musical expert's.

The participants were seated comfortably in a quiet room. Resting pulse rate, breathing pattern, heart rate, were recorded before listening to music by digital physiograph. Standardization was done by recording the average of 3 pulse recording over a period of 2 to 3 consequent days. After listening to each sample of music for 10 minutes, pulse rate and heart rate were recorded. The music was delivered through a head phone, according to the participant's choice from the selected sample of soothing music, with decibel range of 65 to 70 db. The parameters were recorded before and after the sessions.

Exercise Protocol

Moderate exercise was administered, using the bicycle ergometer. Heart rate was monitored and maintained in the range given by Karvonon's formulae [{(220-age) – resting heart rate} * (0.4 to 0.6) + resting heart rate], with changing the load of the pedal by a microcomputer in the ergometer. This level was chosen because of its equivalent to approximately 9 -12 scores of the rating of perceived exertion (Borg index) assuming that resting hart rate is 70 / min for age of 20 [21]. The subject was asked to warm up by cycling in the bicycle ergometer for 3 min at a tension level of 1. After 3 minutes, tension was set up at 2 and cycling was done for 15 minutes for moderate exercise. For moderate exercise rise in heart rate was above 50% which has raised from the basal heart rate of 80 to 120/minute [22].

STATISTICAL ANALYSIS

Data was analysed by using SPSS 20.0 software and statistical tests applied are One-way ANOVA and Tukey HSD Post-hoc Test. Statistical significance was taken to be a p-value of less than 0.05.

RESULTS

[Table/Fig-1] shows demographic data of the participants. In frequency analysis of heart rate variation, the frequency was divided into a low frequency component (LF 0.04 – 0.15Hz) and a high frequency component (0.15 – 0.40Hz). Low frequency and high frequency component was significantly increased followed by only exercise (p-value <0.001) [Table/Fig-2]. Music minimized increase in both high and low frequency component followed by exercise. However, only high frequency change was statistically significant (p-value <0.05) [Table/Fig-2]. LF/HF ratio was significantly increased followed by exercise without music (p-value <0.001). Music significantly minimized increase in LF/HF ratio (p-value <0.001) [Table/Fig-2].

Gender	Age (years)	Height (centimeters)	Weight (kilograms)	BMI (kg/m^2)
Males (n=18)	22.45±1.86	168.45±6.02	61.5±3.5	21.71±1.32
Females (n=12)	22.81±1.72	157.73±5.68	51.27±4.10	20.60±1.23

[Table/Fig-1]: Demographic data

Parameters normalized units(nu)	Baseline normalized units(nu)	Post exercise without music normalized units(nu)	Post exercise with music normalized units(nu)	p-value
Low Frequency (LF)	41.81±5.21	50.49±6.32	47.08±5.82	0.0000**
High Frequency (HF)	57.74±7.46	48.71±6.82	53.97±7.26	0.0000**
LF/HF	0.724±0.07	1.09±0.09	0.87±0.06	0.0000**

[Table/Fig-2]: Mean values of low frequency (LF), High Frequency (HF) and LF/HF. (Values are Mean ± SD) (*P value<0.05 is significant, ** P value<0.001 is significant)

DISCUSSION

The present study was undertaken to investigate whether listening to preferential music has any impact on exercise induced changes in HRV. This study showed that the participants were able to exercise at lower heart rate with music compared to no music during the exercise period for the same intensity of exercise. Thus music improves cardiac efficiency. Our findings are similar with earlier studies which showed a decrease in heart rate with exercise [23,24]. This effect may be due to action of music through parasympathetic nervous system. Music may increase parasympathetic tone and minimize raise in heart rate during exercise [25,26]. Earlier studies also reported that music decreases sympathetic tone and muscle tension and regulate heart rate [27-29]. Music therapy was found beneficial for management of sleep difficulties, pain, anxiety, depression, fatigue, and nausea, and to increase spiritual well-being [30-32]. Earlier studies reported significant decrease in the sympathetic activity followed by acute exposure to heavy metal music [29,33]. On the contrary, other study reported increased autonomic activity during music listening [34]. Raglio et al., reported that music therapy increased the symptoms of depression and also increased HRV in demented patients [35]. Chuang et al., have also reported increase in the HRV but no change was seen in LF/HF ratio of HRV in anthracycline-treated breast cancer patients followed by music therapy [36]. In the present study we have observed significant decrease in LF/HF ratio with music, which may be due to effective overall balance between the sympathetic and parasympathetic nervous systems by music therapy. In our study, since we had selected music preferred by the participants, added to the fact that the subject was in a relaxed mood must have accounted for the music induced alterations in sympathetic and parasympathetic activity during exercise. Our findings are in agreement with the recent works [37,38]. It is clear from our results

that preferred music has a definite calming effect on exercise induced changes in HRV which is in accordance with the work of Pal et al., who have shown that practice of relaxation therapy with soothing music in the background was effective in lowering the LF/HF ratio of HRV in medical students [39]. Therefore listening to preferred music along with exercise has a significant beneficial effect by improving the autonomic balance and therefore has a calming effect on the mind.

LIMITATIONS

The major limitation of the study would include lesser sample size. We didn't maintained control group.

CONCLUSION

As people are becoming increasingly health conscious, more importance is being placed now-a-days on regular exercise. Combining exercise with preferential listening to music is not only enjoyable because of its effect on mood but also makes physical activity an enjoyable experience. This study provides the preliminary evidence that listening to preferential music could be an effective method of relaxation, as indicated by a shift of the autonomic balance towards the parasympathetic activity among medical students.

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