



Effects of Music and Pranayama on Galvanic Skin Resistance: An Observational and Comparative Study

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ABSTRACT

Introduction: Stress is responsible for the ill health of people and substantial economic loss for the society. This study analyses and compares the effects of music and pranayama on stress response among healthy adults by measuring the galvanic skin resistance (GSR).

Methods: Observational and comparative study including ninety subjects of age group 20-30 years of all gender. Baseline GSR was recorded then the subjects were equally divided into three groups. First group, second group and third group (control) were instructed to listen a self-chosen music, to perform Anuloma-viloma pranayama and to sit in silence for 10 minutes respectively. After that GSR was recorded again. Statistical significance was accepted at $p < 0.05$. Analysis of variance (ANOVA) and paired 't' test was used to compare the different study groups and parameters.

Results: Maximum increase in GSR was seen in the group which listened to music and this change in GSR was found to be statistically significant. This was followed by the group which performed pranayama. The least increment was seen in the group which sat in silence. However, in the pranayama and the silence group, the change in GSR was found to be statistically insignificant.

Conclusion: Music appears to be a more effective method for reduction of stress in our study. The implications of these results can help us to find techniques of stress reduction in everyday life.

Keywords: Stress, Music, Pranayama, Galvanic Skin Resistance (GSR).

INTRODUCTION

Prolonged period of stress has been found to be associated with poor individual health^{1, 2} and substantial economic loss for the society.³ Stress is commonly assessed through both physiological as well as subjective measures of participants.⁴

In several studies, stress has been assessed by measuring the heart rate, blood pressure, serum cortisol, and subjective anxiety.^{5, 6} Other studies have included galvanic skin resistance as well.⁷ Galvanic skin resistance (GSR) is an easy, non-invasive and reproducible method of capturing the autonomic nerve response as a parameter of the sweat gland function.⁸

GSR is the tonic level of electrical conductivity of the skin, expressed in microsiemens (μS).⁹ The device used for measuring GSR is usually placed on hands or feet, where the density of sweat glands is the maximum.¹⁰

Music has been found to have significant effects on physiological functions as well as clinical symptoms.¹¹ It has been found to have beneficial effect on stress-related physiological¹²⁻¹⁴, as well as cognitive¹⁵, and emotional processes.¹⁶

The Sanskrit word Pranayama is made up of two words namely Prana (means vital force) and Yama (means control). It consists of three phases: Purak (inhalation), Kumbhak (retention) and Rechak (exhalation).¹⁷ Regular

practice of pranayama has been found to have a positive effect on cardiovascular^{18,19} and respiratory functions^{20,21} and improve the parasympathetic (vagal tone) dominance.^{22,23}

AIMS AND OBJECTIVES:

1. To examine the effect of music on galvanic skin resistance among healthy adults.
2. To assess the effect of pranayama on galvanic skin resistance among healthy adults.
3. To compare the effects of music and pranayama on galvanic skin resistance among healthy adults and find a more effective stress reduction technique.

MATERIALS AND METHODS

Study site: The study was conducted in the Department of Physiology, Darbhanga Medical College & Hospital, Laheriasarai, Bihar.

Study duration: 6 months from October 2023 to March 2024.

Study design: This was an observational and comparative study on 90 healthy subjects of age between 20-30 years and all gender. This study was approved from Institutional Ethics Committee. Written informed consents were obtained from all the subjects and subjects were informed



that their participation in this study would be voluntary in nature.

Inclusion criteria:

- 1) 90 healthy subjects (divided in 3 groups of 30 each) with age group of 20 - 30 years and all gender.
- 2) Subjects consenting to participate in the study.

Exclusion Criteria:

- 1) <20 years and >30 years of ages
- 2) Hearing and speech disorder
- 3) On any medication known to affect electrical activity of heart like anti arrhythmic drug
- 4) Any systemic illness known to produce stress like neuropsychiatric disorders, cardiovascular disease, Respiratory disease, Renal disorder, Endocrine disease etc.
- 5) Aversion to music
- 6) Smoking and Alcoholic habit
- 7) Sleep disorder
- 8) Subjects who regularly practice pranayama

Ninety subjects who consented to participate were assigned to one of the three groups, with thirty participants in each group. Subjects were detailed about procedure of this study and were thoroughly encouraged to ask any doubts of any type to allay anxiety which may result in autonomic disturbances.

Procedure: The Subjects were requested to report at 10 AM in the Physiology Laboratory after having their usual breakfast but they were simultaneously advised not to consume coffee on the day of procedure. After recording of anthropometric data, they were made to sit comfortably in a silent room for 10 minutes and the room temperature was maintained at 25°C. After that a baseline recording of

GSR was taken using psycho feedback machine CBF-206 (Medicaid).²⁴ Galvanic Skin Resistance was measured by placing the surface electrodes on the palmar surface of the left index and ring fingers.

After baseline recording of GSR, the subjects of one group were made to listen to a self-chosen music, second group were made to perform Anuloma-viloma pranayama and third group were instructed to sit in silence for 10 minutes. Then the GSR was recorded again.

Anuloma-viloma Pranayama involves inhaling through one nostril at a time while closing the other nostril manually. In a normal nasal cycle alternating phases of congestion and decongestion of nasal tissue occur, based on the predominance of sympathetic or parasympathetic tone.²⁵ A modified form of Anuloma-viloma Pranayama, with equal phases of inhalation, breath holding, and exhalation (1:1:1 ratio) was used in this study.²⁶ A video tutorial was used to demonstrate the technique of Anuloma-viloma pranayama to the participants.

Statistical analysis:

The data was tabulated and master chart prepared in Microsoft Excel 2016 version. Graph Pad Instat software was used to perform required statistical analysis. Results were presented in Mean \pm SD. Statistical significance was accepted at $p < 0.05$. Analysis of variance (ANOVA) was used to find the significance of the study parameters between the three groups. Paired 't' test was used to compare the study parameters recorded before and after the procedure.

RESULTS

Mean age of studied subjects is 24.45 ± 1.68 years. Mean Height of the population is 1.66 ± 0.05 metres. Mean weight of the population is 63.48 ± 6.01 Kg. Mean BMI of the population is 22.80 ± 1.09 . All the three groups were well matched with respect to age, weight, height and BMI.

Table 1: Comparison of anthropometric parameters of the study groups

Parameters	Music (Mean \pm SD)	Pranayama (Mean \pm SD)	Silence (Mean \pm SD)	P value
Age (in Years)	24.4 \pm 1.52	24.9 \pm 1.44	25.26 \pm 1.77	0.11
Height (in metres)	1.66 \pm 0.07	1.66 \pm 0.05	1.66 \pm 0.03	0.99
Weight (in Kg)	62.96 \pm 8.1	64.46 \pm 5.46	63.03 \pm 3.73	0.55
Body mass index (BMI)	22.57 \pm 1.02	23.14 \pm 1.07	22.69 \pm 1.12	0.09

*Statistical analysis by one way ANOVA; p value < 0.05 – Significant; p value > 0.05 – Non significant

Table 2: Comparison of galvanic skin resistance (in Kilo-ohms) before and after the procedure, among the study groups

Study groups	Baseline (Before procedure) (Mean \pm SD)	After Procedure (Mean \pm SD)	p value (paired t test)
Music (n=30)	390.43 \pm 28.85	415.6 \pm 47.94	0.007
Pranayama(n=30)	387.26 \pm 18.67	391.43 \pm 17.78	0.07
Silence(n=30)	387.86 \pm 29.28	391.13 \pm 20.51	0.14
p value (one way ANOVA)	0.88	0.004	

p value < 0.05 – Significant; p value > 0.05 – Non significant



In terms of GSR, mean baseline for all participants (n=90) was 388.52 Kilo ohms with a standard deviation of 25.81 Kilo Ohms.

For participants who listened to music (n=30), the mean baseline GSR was 390.43 Kilo ohms with a standard deviation of 28.85 Kilo ohms, the mean value after listening to music was 415.6 Kilo ohms with a standard deviation of 47.94 Kilo ohms. This difference in the mean value of GSR was found to be statistically significant ($p < 0.05$).

For participants who did pranayama (n=30), the mean baseline GSR was 387.26 Kilo ohms with a standard deviation of 18.67 Kilo ohms; the mean value after the pranayama was 391.43 Kilo ohms with a standard deviation of 17.78 Kilo ohms. This change in the GSR was found to be statistically insignificant.

For participants who sat in silence (n=30), the mean baseline GSR was 387.86 Kilo ohms with a standard deviation of 29.28 Kilo ohms, the mean value after sitting in silence was 391.13 Kilo ohms with a standard deviation of 20.51 Kilo ohms. This change in the GSR was found to be statistically insignificant.

DISCUSSION

The present study was undertaken to compare the effects of music and pranayama on galvanic skin resistance among healthy adults and find out the most effective stress reduction technique.

Subjects with age group of 20-30 years were chosen. Young population in this age group faces similar kind of stressors. Secondly, the various cardiovascular parameters change with increasing age. Participants in one of the groups listened to self-chosen music. Self-chosen music was used because music preference has been shown to have a significant role on stress reduction, even overriding the influence of other components of music.²⁷

Anuloma-viloma pranayama with inhalation, breath holding, and exhalation in the ratio of 1:4:2 is an advanced method which is not suitable for beginners. Moreover, the increased duration of breath holding may be harmful.²⁸ Hence, a modified form of Anuloma-viloma, with equal phases of inhalation, breath holding, and exhalation (1:1:1 ratio) was used in this study.

All the three groups showed higher GSR levels after the procedure compared to the baseline levels. Those who listened to music showed the maximum increase in average GSR, and this change was found to be statistically significant. This was followed by those who performed the pranayama. Participants who sat in silence, however, exhibited least increase in GSR level than all the other groups. However, in pranayama and silence group, this increase was found to be statistically insignificant.

Nida J et al in their study compared the effects of music and breathing exercises in reducing the physiological symptoms of stress. The physiological indicators of stress measured in their study were blood pressure, heart rate, and

electrodermal activity (EDA). To induce anxiety, participants underwent an abbreviated Trier Social Stress Test. Following the stress phase, one group of participants (n=10) sat in silence, one group (n=10) listened to music, and the last group (n=10) performed a breathing exercise. GSR was found to be increased in the groups which either listened to music or sat in silence. However, in their study, GSR decreased in the participants who performed breathing exercise.²⁹

GSR is the electrical resistance offered by the skin, when a weak electric current passes between two electrodes placed on the skin. The GSR of the skin depends on various factors, the most important of which is the presence or absence of sweat. The presence of water and electrolytes in the sweat decreases the resistance to passage of current, and hence decreases the GSR. An increase in the sympathetic tone, increases sweating and thereby, decreases the GSR.³⁰

Both Music and Pranayama helps decrease the sympathetic tone and simultaneously increase the parasympathetic tone.³¹⁻³³ However, this effect of pranayama appears to occur after regular practice. This notion is supported by the study of Dhodi Dinesh K et al.³⁰ In their study, a significant increase in the GSR reading was observed on the 30th day after daily practice of pranayama while a slight increase was seen on the 15th day. This indicates a significant decrease in the sympathetic tone following daily practices of Pranayama.

LIMITATIONS OF THE CURRENT STUDY

The group who did Anuloma-Viloma pranayama may have had avidity towards music but since the creation of the group was random, they were kept in group who did Anuloma – viloma pranayama. Our result is the outcome of single session of pranayama which is different from the music group since the subjects may have had multiple prior exposures to music and this may have had potentiating effect. A study can be taken in a way were Anuloma – viloma pranayama group can be subjected to long term practice and then the comparison could be undertaken.

CONCLUSION

A single session of self-chosen music for 10 minutes significantly raises the galvanic skin resistance which signifies reduction in stress. Similarly, a single session of pranayama for 10 minutes also raises the galvanic skin resistance. However, this change is statistically insignificant.

Thus, though, both self-chosen music and pranayama resulted in increase in GSR, statistically significant change was only seen in the group which listened to music. Hence, music appears to be a more effective method for reduction of stress in our study.

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