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EFFECT OF LISTENING TO A RELAXING WATER SOUND FOR FIFTEEN MINUTES ON TRAUMATIC STRESS SUBJECTS' IMMEDIATE STRESS LEVELS AND ELECTROENCEPHALOGRAMS

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ABSTRACT

BACKGROUND: Music and calmness are noteworthy stimulators that significantly affect mental health. Listening to relaxing sounds activates the feeling of wellbeing. The present study aimed to analyze the effect of closed eyes brief exposure to a relaxing water sound on Electroencephalogram (EEG) in pre and post-test states.

METHODOLOGY: A total of 20 traumatic stress subjects were included to participate in this study. The subjects were requested to be seated with eyes closed while the sound of water flowing was played for 15 min in between (before and after) the EEG recordings. A subsection of the Sadaf Stress Scale (SSS) i.e. traumatic stress scale was used to assess the traumatic stress and muse (SCR_014418) monitor headband was utilized for EEG evaluation i.e. Alpha waves, Beta waves, Theta waves & Delta waves.

RESULTS: Significantly increased theta wave & alpha waves were found after the listening of relaxing water sound in the eyes-closed state. While no significant change was observed in beta & delta waves.

Conclusion: The results of this study suggest that exposure to the sound of water flowing quietly significantly generates alteration in brain waves. Although, the applied stimulators were for a brief period changes in frequencies suggest if applied for a longer period it could generate a relaxation state.

KEYWORDS

Traumatic Stress, EEG, Audio-Feedback, Brain Waves, MUSE Monitor.

INTRODUCTION

The psychophysiological wellbeing of the population in Pakistan is challenging with constant exposure to chronic stressors like poor law and order situations, weaker socio-economic status, and reduced health facilities^{1, 2}. In addition to these academics have also contributed to the mental and physical stress among students³. There has been reported an epidemic of mental illnesses in Pakistan, most commonly traumatic Stress Disorder, Generalized Anxiety disorder, and depression leading toward chronic neurological and health issues^{2, 4, 5}. Stress responses are now being recognized as a collective emotion of experiences which has an adverse effect on the quality of life, distressing both physical and mental health. Though, to evaluate and screen stress always become challenging because of individual physiognomies in diverse ways.

However, numerous tools and techniques have been developed and tested to quantify stress e.g. questionnaire-based methods such as Perceived Stress Scale (PSS), Stress Response Inventory (SRI), and Hamilton Depression Rating Scale (HDRS) along with other alternate techniques of measuring the alterations of physiological signals such as Electroencephalography (EEG), Galvanic skin response (GSR), Electrocardiography (ECG), Plethysmography, Skin temperature, etc. Out of these, most of the work is on EEG based stress recognition⁶⁻¹¹. EEG is identified as an elegant non-invasive procedure that also collects responses from the body via brain waves, while distress is a measure of decreased frequency of alpha waves¹². One of the important tools that cause alteration in feelings, mental activities, and learning abilities is

music¹³. Globally, the traumatic stress associated research work revolves around the debate on the interconnection between the traumatic stress and Post-Traumatic Stress Disorder (PTSD). While locally the published studies are rare but the randomized control trials are planned to observe the psychophysiological alterations associated with PTG among the traumatic stress subjects¹⁴.

Many studies highlighted that the anatomy of the nervous system is significantly¹⁵ affected by the music-related stimulus and also has an influence on the mesolimbic reward pathway, these responses have resemblance with the primary (i.e. food, sex) reward and secondary (money) rewards^{16,17}. In another study, it was mentioned that dopamine release is the same as in the biological reward system in striatal regions, mainly in Nucleus Accumbens (NAcc) and caudate¹⁸. Mental fatigue can be prevented by listening to music¹⁸ and also has prominent effects on reasoning and cognitive functions¹⁹. It is well understood that different sound frequencies or simply non-identical musical sounds produce different effects on emotions. Even happy or sad music can activate different physiological reactions of the body, a zygomatic muscular activity can be initiated by happy music, and the zygomatic muscle involved increment of respiratory rate and skin conductance and corrugator muscles triggered by the sad music^{15,20,21}. Such a relaxing sound may offer a more accessible and less stigmatizing therapeutic option for treating posttraumatic stress²¹. Existing evidence suggests that pleasant sounds reduce stress and unease in non-clinical populations and have the potential to improve psychophysiological outcomes as well as foster resilience among individuals struggling with posttraumatic stress, however it requires proper follow-up. There is slight evidence to propose that subjects with traumatic stress exposure may derive benefits from listening to relaxing sounds. The present study aimed to analyze the effect of listening to a relaxing sound of water flowing among traumatic stress subjects.

METHODOLOGY

This non-randomized study was conducted in the Psychophysiology Research Lab, University of Karachi, Pakistan. The study was conducted following the Declaration of Helsinki, and Ethical approval for this protocol was obtained from the Independent ethics committee. University students age between 18-24 years, having no psychiatric and neurodegenerative disorder, were invited to participate in this study. The objectives and protocol of the study were explained to the participants. Written and signed informed consent from subjects was obtained before inclusion. In the

commencement of the study, basic information was collected from all subjects through a questionnaire, which included questions related to their demographic, socioeconomic status, marital status, medical history, substance use/abuse, perceived stress, and current health status. A subsection of SSS22, i.e. traumatic stress scale, was used to assess the traumatic stress and muse (SCR_014418) monitor headband was utilized for EEG evaluation, i.e. Alpha waves, Beta waves, Theta waves & Delta waves. The MUSE EEG system has electrodes located analogously to Fpz, AF7, AF8, TP9, and TP10 with electrode Fpz utilized as the reference electrode. The circumstances in which a person itself or his/her loved one experience a dreadful situation or trauma, for instance, domestic violence, natural or artificial miseries ultimately results in traumatic stress¹. The afterward symptoms of fright, unable to help oneself, and disturbance can resolve with the time that is considered as Acute Stress Disorder (ASD) but if it persists one should consult proper psychological treatment because it can be a Post-Traumatic Stress Disorder (PTSD). The evaluation of the subject's traumatic stress was conducted through a subsection of SSS²². The subsection has a total of 8 questions for their perspective related to their trauma. It was graded in five categories from never to very frequent. A total of 20 traumatic stress subjects have participated in the study. The subjects were included from the University of Karachi, Koochi Goth Hospital, and Markaz-e-Umeed. The subjects visited the psychophysiology research lab for EEG testing. They were requested to be seated with eyes closed, and the water flowing sound was applied for 15 min in between (before and after) the EEG recordings. The collected data was analyzed using SPSS version 22.0.

RESULT

The demographic characteristics of the study participants are displayed in Table 1

Table 1: Demographic characteristics of study participants

Variables		n=20
Gender	Male	5(25)
	Female	15(75)
Ethnicity	Sindhi	4(20)
	Balochi	3(15)
	Punjabi	5(25)
	Muhajir	8(40)
Sex Orientation	Gay/Lesbian	1(5)
	Straight/Heterosexual	19(95)
Occupation	Student (Not Working)	17(85)
	Student (Part-Time Job or Business)	3(15)
Marital Status	Single	14(70)
	In a relationship	6(30)
Religion	Religious	20(100)
	Conservative	4(20)
Politics	Moderate	13(65)
	Liberal	3(15)
Tobacco	Yes	2(10)
	No	18(90)

*Values are given as n (%)

The peer group that was recruited in the study were more female than male. The study participants have some contrasting features, for instance, ethnicity, religious beliefs, and fitness. That ultimately affect their way of thinking and to deal or understand stress.

Table 2: Mean Power Values and standard deviation of study participants**before and after the test**

Measurements	Pre-test	Post-test	p-value
	Mean ± SD		
Alpha (Power Units)	9.17±3.67	12.91±4.89	<0.001
Beta (Power Units)	0.93±0.09	0.95±0.11	NS
Theta (Power Units)	4.85±1.22	5.96±2.42	<0.001
Delta (Power Units)	2.42±0.41	2.37±0.53	NS

*NS: non-significant

This work was done to observe the effectiveness of listening to a relaxing water sound for 15 minutes on traumatic subjects. It seems that alpha waves mean value inclined towards the higher side as well as the mean value of theta waves, this shows that subjects have a relaxed scenario. In contrast, the other two waves did not exhibit any significant or noticeable change in their pattern after the test state.

DISCUSSION

The novelty of the present study is that listening to a relaxing water sound for 15 minutes significantly increased the theta and alpha waves in the post-test state. The study mentioned the remarkable changes in

the patterns of brain waves after the subjects asked to close their eyes. These results concur with the previous work done that focuses on the response of alpha in the eyes-closed state for a different purpose, reporting similar brain wave patterns. In this study, subjects showed a higher alpha frequency after closing their eyes. Another study was performed that analyzed the effect of closed eyes on alpha activity; the alpha waves were significantly increased after the subjects closed their eyes²³. Many studies have supported that the alpha waves must rise in a relaxed state of mind. One of the studies was performed to assess the effect of relaxing music on one's mental and physical health and found an increase in alpha after proper follow-up sessions²⁴. The results of the study suggesting the same behavior of alpha, however with proper session's major effects on wellbeing could be observed. The theta wave is considered to be involved in a more relaxed state or hypnotizing state. The recorded data shows that the theta wave increased in the post-test state. Maity, A. K. applied acoustical stimuli on 10 participants and concluded that theta wave was increased²⁵. The declined theta wave proved that the respondent was disturbed or in a distressed condition. A study included the subjects that suffered from PTSD concluded that the patients had shown a significant decline in theta wave²⁶. One of the studies was performed on veterans has reported an increase in theta wave after Auditory neurofeedback therapy in PTSD patients²⁷. Slow waves or delta waves are considered to be the most prominent during sleep. The results showed a slight decrease in the mean of delta waves in the post-meditation state. The subject closed his/her eyes throughout the progression of the test. Franke, L. M.²⁶ proceeded with the work on the patients of PTSD, and the outcomes showed a decline in delta waves. Fifteen subjects were selected that experienced psychotic episodes recently, the records were taken in eyes closed relax state and with listening to music in the same state, the data reported a decrease in the frequency of delta waves²⁸. The waves that can be observed during concentrations, learning, and mentally alert state are beta waves. The beta waves did not show any profound changes after the neurofeedback training. This could be due to the deep subconscious or conscious involvement of the participant in the completion of the upcoming tasks. The load on the brain may significantly affect the beta oscillations and fail to relax the waves. Another study suggests that consciousness involving tasks can cause a noticeable increase in beta waves²⁹. So, it can be said that the un-responded result of beta waves was due to the involvement of the brain in some other tasks. Another study was designed to observe the EEG after alpha

music was applied to healthy subjects but emotionally depressed or anxious reported a 40% decline in beta frequency from initially recorded data³⁰. A study was performed to assess the association between brain waves and stress analyzed through EEG after the auditory meditation applied, the researcher suggested that the gamma waves are not linked with stress directly like other waves³¹. The reason behind this outcome might be the intensities of sound, as different intensities of sound are required for the initiation of brain waves with different amplitudes.

CONCLUSION

These novel EEG findings correlated with their closed eyes suggest that the relaxing water sound stimulus significantly affects the traumatized subjects, and to some extent ease their mental burden in the post-test

state. Music is known for its use therapeutic agent for ages, the same is found in the study when the patterns of theta and alpha waves were significantly altered which is indicating a minor relaxing state of the subjects. However, the changes in frequencies are less, but they can effective when using for a longer period or in the follow-up study. Further work is still required to delineate the possible functions of listening to relaxing water sounds for a few minutes on distress subjects.

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S Farah Jafri; data collection, data analysis, manuscript writing, manuscript review

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