Music therapy in insomnia

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Abstract. Insomnia, as a problem plaguing most people in modern society affecting 30% population in the worldwide, is the phenomenon of not being able to sleep mainly due to emotional problems; most of the emotional problems leading to insomnia are negative emotions, such as anxiety and depression. Music therapy is now greatly emphasized in psychiatric treatment and is gradually entering the clinical stage of depression and anxiety treatment. Here, this review first introduces the classification of emotions and EEG, which was used to record the brain waves and analyze and visualize the effects of different types of music on neuronal activity, and help to select the the most effective types of music to treat insomnia, then focuses on the application of music therapy in the treatment of insomnia through a case, such as music affecting the neuronal activity of the brain and mood adjustment to induce sleep and even deep sleep. The purpose of this review is to to make staffs in related fields pay attention to the role of music in the treatment of insomnia, and to provide ideas and directions for future research in this field.

Keywords: Insomnia, Brainwave, Brain activity, Temporal pattern, Music therapy, Emotion.

1. Introduction

Insomnia, as a problem plaguing most people in modern society, is the phenomenon of not being able to sleep mainly due to emotional problems; most of the emotional problems leading to insomnia are negative emotions, such as anxiety and depression [1].

Most treatments for insomnia in modern society are through medication. The introduction of sleeping pills is an effective solution to the problem of falling asleep but is accompanied by great side effects. For example, long-term dependence on medication leads to withdrawal and rebound phenomenon, central nervous system disorders lead to personality changes, and memory loss affects the balance of the brain. Since insomnia is mostly triggered by a buildup of negative emotions, there are now many scientific studies proving the positive effects of music therapy on depression and anxiety [2,3].

Neural activity can be seen as a bridge between building human feelings and emotions and scientific disciplines, and observing and summarizing neuronal activity can analyze the relationship between brain activity and emotions from a scientific perspective [4].

Electroencephalogram (EEG) records electrical signals in the brain by using small metal discs called electrodes, which come into contact with the scalp and communicate with neurons in the brain, and then present these responses in the form of an EEG image, which visualizes brain activity in the form of wavy lines on the image. Therefore, EEG has an important role to play in psychiatry, which can assist in the diagnosis of insomnia, brain tumors, brain trauma, and brain dysfunction, etc. [4].

Here, this review first introduces the classification of emotions and EEG, which was used to record the brain waves and analyze and visualize the effects of different types of music on neuronal activity, and help to select the the most effective types of music to treat insomnia, then focuses on the application of music therapy in the treatment of insomnia through a case, such as music affecting the neuronal activity of the brain and mood adjustment to induce sleep and even deep sleep. The purpose of this review is to to make staffs in related fields pay attention to the role of music in the treatment of insomnia, and to provide ideas and directions for future research in this field.

2. Categorization of emotions

According to the paper of emotion and brain waves, Dr. Aparna Ashtaputre et al described emotionality as an acute psychological disturbance of the whole organism, which mainly derived from behavior, conscious experiences, and visceral functioning. In the domain of psychology, Plutchik's Wheel of Emotions classifies human emotions into eight primary emotions including anger, anticipation, joy, trust, fear, surprise, sadness and disgust. Each of them has a polar opposite (Table 1) [4].

Table 1. The classification of emotion.

Emotions and Opposites	Physiology
Joy-Sadness	Connect-Withdrawl
Fear-Anger	Get small and hide-Get big and loud
Anticipation-Surprise	Examine closely-Jump back
Trust-Disgust	Embrace-Reject

The complexity of human emotions then arises from a mixture of two or three of the basic emotions mentioned above. Behind these emotions are usually different neuronal activities, which can be summarized and categorized emotions more deeply through analyzing brain waves.

3. Categorization of brain waves

Due to the shape of the brainwave oscillating, they are usually classified into five broad categories with different frequencies and amplitudes called alpha (α) band, beta (β) band, theta (θ) band, delta (δ) band, and gamma (γ) band. By observing the images of brain waves, the characteristics of five kinds of brain waves can be summarized. The frequency from fast to slow is gamma > beta > alpha > theta > delta. The amplitude sizes of the five kinds of brain waves are comparable, but without obvious differences. The faster the frequency of neuronal activity, the more focused the mind is, and the higher the mood is; the slower the frequency of neuronal activity, the more disorganized the mind is and the more relaxed the mood is [5].

In the study of sleep, it is usually divided into five stages including W stage, N1 stage, N2 stage, N3 stage, and REM stage, which is original band, frequencies, characteristics and stages in table 2. The abnormal sleep stages are mainly in the first two stages in patients of insomnia. The W stage is abbreviation for wake stage, which is usually dominated by beta waves or alpha waves, which have both higher frequencies and lower amplitudes. However, the beta waves tend to be more awake in the W stage, while the alpha waves are mainly found in the drowsy state. The alpha stage is dominated by drowsiness in the N1 stage, gradually moves to the theta stage, which is a more relaxed state of light sleep, where the breathing rate becomes more regular and the body muscles relax (Table 2) [6].

Table 2. The classification of brain waves and features.

Brain waves	Frequency	Brain state	Sleeping stage
Alpha (α) band	9-13Hz	Restful; awake; "basic rhythm" state	W
Beta (β) band	13-30Hz	Active mind	REM/W
Theta (θ) Band	4-8Hz	Drowsiness; meditation; relaxed	N1
Delta (δ) Band	0.5-4Hz	Deeply relaxed; oftenly seen in deep sleep	N3
Gamma (γ) Band	35Hz	Active; energetic; concentrated	/

In order to make the brain waves gradually enter the transition stage of theta band state or alpha band state, the types of music with alpha waves or theta waves can be introduced to contact with the auditory nerves, thus achieve the effect of soothing emotions and muscle relaxation, eventually help to sleep easily.

4. Music therapy for insomnia: case studies

4.1. Music treatment of insomnia student

The problems of poor sleep quality and insomnia in students have been more and more serious in nowadays because of intensive courses, stress of examination, vulnerable emotions of young people, and some pysical diseases, especially for medical students even with a incidence between 40-60% [7].

In this paper, a college student was reported who suffered from insomnia through EEG scanning, and treated in different genres of music. The subject' sleep duration like the time taken to fall asleep and anxiety levels were assessed before the experiment began, which were recorded as a control group to compared with the results after the experiment using music treatment.

During the experiment, the subject fell asleep with alpha waves music as background music. The changes of heart rate, brain waves and respiratory rate of the subject were measured and recorded. After waking up, the researchers had a discussion about the music and and the subjective perception of the sleep quality status of this student. During the experiment, the data related to factors music itself were also collected, such as the frequency of occurrence of notes, the playing instruments, and the melodic beats, etc., as well as summarized the most suitable music for this subject with insomnia in the sleep environment.

During the three-week experiment, the researchers found that the quality of sleep of high school students gradually improved, and the time needed to fall asleep was also shortened. With enough sleep, the anxiety level was also reduced, and the bedtime state gradually changed from intense and hyperactive to quiet and focused. Overall, music therapy is effective in improving insomnia and sleep quality in this case [8].

4.2. Music treatment of insomnia in duration of COVID-19 pandemic

The symptoms of sleep disorder and chronic insomnia were increased significantly because of negative emotions like anxiety in the stage of COVID-19. In a report using cross-sectional analyses and mixed-effects models with 3560 participants, the authors finded that the emotion of worring about virus pandemic is the most associated fator with serious of insomnia [9].

In this review, the author chose a research case in which music improved the sleep problems and insomnia with medical staff in the virus pandemic, simplyfied discussing the therapeutic mechanisms of music. In this study, 34 clinical staffs working with COVID-19 patients were spontaneous agreed to be treated with remote receptive music intervention for 5 weeks. The results suggested that music therapy can be a very effective measure for medical staff to improvement their sleep problemes and associated negative emotions, especially in emergencies like highly stressful situations. Furhtermore,

the researchers discussed the treatment mechanisms of music therapy through reduction the activity of the hypothalamic pituitary and adrenal axis, leading to dowmregulation of cortisol level, eventually improved functions of psycho-neuro-immune-endocrine. Therefore, the researchers suggested that music can also be used to effectively improve the subjects' negative emotions such as fatigue, sadness, fear, and worry, which is suitable for staffs who worked with high-stress conditions [10].

5. Summary

Until now, insomnia is a common mental illness, mainly caused by negative emotions, stress or certain physical diseases, affecting 30% of the world's population. Music, as a therapeutic method without pharmacology, can be used for treatment of sleep disorders, insomnia and other associated sleep problems through increasing the sleep quality of individuals, which has broad application prospects and research value because of its optimistic curative effect, without obvious adverse reactions and easy access to get the therapeutic music. However, it needs to be considered to explore and improve some aspects in the future, such as how to choose appropriate music for treatment, standardization of treatment approaches and how to objectively evaluate treatment effects. In addition, the therapeutic mechanisms of music also need to be focused on exploring in depth in the next few years.

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