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Therapeutic Effects of Music: A Review

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Abstract
Introduction: Side effects of most synthetic drugs used in the treatment of various diseases have led researchers around the world to conduct studies on the identification of alternative therapies. In this vein, the present study aims to review the research carried out in association with the therapeutic effects of music used in the treatment of relatively common diseases.
Methods: To develop this review article, researchers conducted some computer search using keywords in databases including Google scholar, SID, Iranmedex, Medline, PubMed, Springer, Science Direct, ProQuest, and ISC, and collected and probed the results of over 100 published articles from 2000 to 2018 dealing with the effect of music therapy in the treatment of 12 relatively common diseases.
Results: The findings show that music therapy has a positive effect on the treatment of the diseases studied.
Conclusion: Music can have positive effects on pain, sleep disorders, learning, memory, IQ, depression, anxiety and special diseases such as schizophrenia and autism.
Keywords: Music, Treatment, Disorder

Introduction
Music is an existing portion of all human beings. There are beats and rhythms in our heart rate, and in our breaths and movements as well. Melody has been created in our laughs, cries, screams or songs. Our entire range of emotions can be expressed in different rhythms and harmonies, styles and musical terms. Musical sounds, due to affective and emotional loads, have a profound effect on morale, personality, and the cultivation of human emotions. The idea that music can be used as having a therapeutic effect to heal and improve health and behavior at least dates back to Aristotle and Plato's writings, and has since undergone many courses. Music therapy has been defined by the Australian music therapy association as "the creative and planned use of music for health and vitality and preservation". Or in accordance with what the American music therapy association (1999) has stated; the attitude to music therapy comprises "the use of music in order to achieve the goals of therapy, that is to improve, maintain and promote the health of the mind and body" (1). Music is a valuable tool for stimulating excitement, and processing and receiving music sensations do not require to recognize and understand the melody. Neural networks in the brain are sensitive to the perception of music (e.g., substrate, rhythm, intensity of sound, etc.), so that alteration in each of the factors in a melody (song) can be associated with the reactions of each of the related brain centers. According to the arousal- manner hypothesis, listening to music affects arousal and manner.
In fact, the manipulation and alteration in the structure of limbic and melodic music are accompanied by changes in mood and arousal, as changing elements such as mode, the complexity of harmony and rhythm contribute to the creation of the valence and the positive and negative emotions, while altering other elements such as beat, accent, and rhythm affect stimulating arousal (2). Today, the side

effects of most synthetic drugs used in the treatment of various diseases have led to alternative or complementary therapies such as music, massage, physical relaxation, psychodrama, and the same therapies as interventions in which no drug is used to treat various disorders (3- 6). Music has long been a favorite of humans, and its long history reflects the importance of music in human life (7). Music is one of the most attractive branches of art, which is associated with mobility, energy generation and abstraction, and is used in various branches of medicine, psychology and counseling (8). Today, the use of non-pharmacological methods to relieve pain and disturbances such as anxiety is increasing, and one of these methods is the use of pleasant audio stimuli and music therapy (9). The findings suggest that music therapy can be used as a psychological treatment in various situations and diseases (10). In this vein, considering the interest of different human societies in music around the world, as well as the tendency of medical specialists to use new therapies that have positive effects on various diseases and lack side effects of chemical drugs, the current study, drawing on over 100 papers published in 2000- 2018 worldwide, aims to review the effects of music therapy on 12 relatively common illnesses all over the world.

Music and attention deficit hyperactivity disorder

Attention deficit hyperactivity disorder (ADHD) is rather one of the most prevalent diseases. Research has shown that music therapy is most likely to reduce aggression and attention deficit hyperactivity disorder in children with ADHD through modification of brain function (11). Music, on the one hand, with the increase of dopamine in different regions of the brain, prevents aggressive behaviors and, on the other hand, by improving the function of the pre- frontal regions and other parts of the brain that have been affected in these patients, improves the disease in children with ADHD disorder (12). It has been shown that listening to music can improve attention and memory performance (13). The results of a study show that music, dance and rhythmic movements cause positive changes in the emotional and behavioral symptoms of 5 to 7 year-old boys with ADHD disorder (14). Another study showed that the implementation of music therapy is useful in the treatment of children with ADHD disorder (15). It has also been shown that music therapy along with rhythmic body movements, individually or chorally, has a positive effect on symptom correction of the disease in children with ADHD, and the effects of group therapy are greater than individual treatment (16). Given that studies have shown interactions between the musical centers of the brain at the temporal lobe and the brain segments involved in ADHD, (17) therefore, music by modifying the operations of these centers may improve the disease.

Music and pain relief

A study revealed that gentle and mild music is likely to relieve the pain through opioid and dopamine systems in the brain (18). A review in cancer patients showed that music therapy could be used as a non-invasive method to reduce pain (19). In a study regarding the impact of two non-pharmacological pain-relieving methods (music therapy and progressive muscle relaxation) on the amount of pain in cancer patients, it was indicated that both music therapy and progressive muscle relaxation techniques are effective in reducing pain (20); also it was shown that progressive muscle relaxation and relaxing music along with other common interventions are effective in reducing the severity of fatigue and pain in patients with breast cancer (21). Music with the stimulation of opioidergic neurons and the increase of opioid substances, such as endorphins, reduces pain, heart rate, and blood pressure (22). Also, music relieves the pain by reducing the severity of depression and anxiety (23). Music therapy is a method that

plays a role in pain relief, reduces the need for analgesic drugs and hence eliminates the side effects of analgesics (24).

Music, memory and learning

Musical and rhythmic activities, due to rhythm and beat that play an important role in the time perception and mental meditation, increase mental abilities and working memory (25). The results of a study showed that the use of music therapy can improve the return of autobiographical memory in people with Alzheimer's disorder (26). The results of another study showed that listening to classical music could improve the performance of working memory in students. Therefore, it is recommended that classical music be used in working environments where memory performance is important. Another study on the effect of memory attenuation and light music on the onset of morphine dependence on adult male rat using conditioned place preference showed that relaxing music is likely to increase the activity of dopaminergic neurons, and so elevates morphine-induced conditioned place preference (28). It has been shown that the treatment with pleasant music through improving memory helps to cure Alzheimer's disease, and in fact the learning power can be increased up to 5 times using this kind of music (29). Listening to music strengthens memory and stimulates dopaminergic neurons in the brain, causing positive inspiration in the individual (30). In another review, it was shown that group music therapy reduces the agitated behaviors of elderly women with Alzheimer's disease (31). Music therapy reduces the non-aggressive, aggressive, and restless physical behaviors of elderly individuals with Alzheimer's disease (32- 34). Musical education is the key to the involvement and maintenance of brain systems involved in the acknowledged attention and memory (26). It has been shown in a study that music therapy reduces behavioral disorders in patients with dementia (35). It has also been shown that working memory in musicians is stronger than non-musicians (36).

Music and addiction

Pleasant music activates various regions in the Brain; such as the nucleus accumbens, orbitofrontal cortex, Insula regions, anterior cerebellum, thalamus, ventral striatum, amygdala, and complementary motor regions that interfere with motivation processes as well as pleasure and reward gain (37). Studies have shown that the reinforcement, reward and relaxation aspects of listening to music are concerned with dopaminergic stimuli and increasing the release of dopamine in the nucleus accumbens and ventral tegmentum and increasing the neurotransmitter of GABA in the amygdala and other areas of the limbic system (38, 39). In another study, it was shown that rushing music increases morphine dependence in the conditioned place preference model, while slow music lacks such an effect (40). According to the findings of a study, it can be said that music therapy is a useful method in reducing the relapse of depression and the stress of drug addicts, so music therapy can be used as an effective way for the treatment of addiction consequences (41). Still again, in another study it was shown that music has no effect on the performance of the pituitary-adrenal axis, and also on inflammation caused by carrageenan injection (42), so the analgesic effects of music are through pathways other than reducing inflammation or steroid hormones. The results of studies have shown that music stimulates oxytocin secretion in the brain and thereby by stimulating and increasing the secretion of morphine-like materials, reduces the sensation of pain (43- 45). Also, serotonin is one of the most important neurotransmitters in relieving pain, and music increases its analgesic effect by increasing this neurotransmitter (46).

Music and spiritual health

A study on the effectiveness of relaxing and instrumental music on the spiritual health of

adolescent girls in Shiraz showed that relaxing and instrumental music significantly and effectively enhances the spiritual health of female adolescents (47). Music plays an important role in outpouring emotions and awareness of the self and environment, and when speaking is not effective, music expands emotions, empathy and sympathy; also it can be used as an effective means for people who seek sense, hope, and recognition (48). In this regard, a study has shown that listening to music along with spiritual therapy reduces depression, anxiety and stress in pregnant women (49).

Music and childbirth

Labor pain is one of the most excruciating experiences of women in which relieving the pain is upmost major goal of midwifery care, because this pain can have plenty of adverse effects on the mother and the baby (50). Psychological empowerment and the protection of women during childbirth also have an impact on the health of their children (51). Regarding the side effects of chemical drugs on the mother and the embryo during pregnancy and delivery, the use of non-pharmacological methods in the reduction of labor pain and the duration of labor has been studied by various researchers. In the meantime, research reveals the positive effects of methods such as massage therapy and music therapy on the severity of pain and the duration of labor, both during pregnancy and at the time of delivery (52, 53). The results of a study showed that music therapy reduced the pain and delivery time in primiparous women (52). Another study also found that listening to music had a positive effect on the process of delivery and reduced time, pain and anxiety during delivery, and also had a positive effect on the maternal parameters of the fetus (54). Listening to fast-tempo music in the active phase of labor can reduce the amount of pain and the length of delivery (55). The results of another study showed that slow-paced music reduces labor pain, however, it does not affect if it continues for more than 3 hours (56). In another study, it was shown that in primiparous pregnant women, music therapy reduced the pain and anxiety of the latent phase, while it doesn't affect the active phase (57). In addition, in a clinical trial, it was shown that music therapy has no effect on pain and delivery (58). The results of a study showed that music therapy in mothers undergoing cesarean section before entering the operating room reduced the amount of anxiety and postoperative pain and shortened the recovery of the patient. Therefore, this treatment should be considered by doctors, nurses and medical staff (59). Also, the results of studies have shown that therapeutic methods, such as massage therapy and music therapy that reduce the level of anxiety and increase the level of brain opioids, reduce the labor pain and the duration of delivery (59, 60).

Music and anxiety treatment

Anxiety is one of the diseases that is most prevalent in behavioral problems (61). Music through distraction of the senses of anxiety stimulators can be implemented to treat anxiety disorders (62). Music increases the alpha waves or brain relaxation wave and thus causes a relaxing condition (22). The results of a study showed that music therapy before surgery in mothers undergoing cesarean section reduced the amount of anxiety and postoperative pain and shortened the recovery of the patient. Therefore, it is necessary for this treatment to be considered by doctors, nurses and medical staff (59, 63). Music, especially of the familiar type, can have positive effects in reducing anxiety, pain and control of some of the vital signs of patients (64). In a study, music therapy in mothers under cesarean section was shown to reduce anxiety and pain (65). Music therapy also reduces anxiety in patients with Alzheimer's disease (66). Music is widely used to reduce stress and anxiety and to improve health (67). Music therapy has also reduced anxiety in

mice treated with simvastatin (68). It has been argued that music has psychological benefits such as reducing fear and anxiety as well as enhancing mood and a feeling of relaxation (69). Music creates positive excitement and affection in individuals (70). Music therapy has been shown to be effective in reducing anger, depression and anxiety, as well as improving social skills for adolescents (71).

Music and cardiovascular disorders

Music reduces the amount of resting heart rate, blood pressure and respiratory rate (72). The results of a review show that music expands cardiovascular function, respiratory function and milk sucking; improves sleep patterns of premature children, and also decreases the stress of their parents (73). In one study, music was shown to have a significant effect on systolic and diastolic blood pressure in individuals during dental root canal treatment, so that changes in blood pressure can be prevented using music during root canal treatment (74). Listening to music or instrumental sounds has a dramatic effect by reducing the secretion of catecholamines on systolic and diastolic blood pressure and heart rate (3, 75). Music therapy exerts its antihypertensive effects through reducing the risk factors involved in cardiovascular disorders and moderating the effects of the autonomic nervous system on heart rate (76). However, the results of a study showed that immediately after the end of a high intensity exercise listening to music during the initial phase of recovery, reduced the efficiency of cardio-respiratory system by reducing the stroke volume and the current volume and increasing the number of respiration and heart rate (77).

Music and sleep disorders

Sleep is one of the basic needs of human beings. Sleep deprivation has many harmful effects on human body and spirit. Considering the importance of sleep for patients admitted to the cardiac care unit, meeting this essential need using sensory stimuli such as music and massage is mandatory (78). The results of a study showed that the use of instrumental music can be effective in improving the quality and quantity of sleep in patients, and nurses can use this non-pharmacological method in their usual care to improve their patients' sleep (79).

Music and depression

Depression is one of the common psychological disorders that is associated with biochemical, cognitive, behavioral, and psychological changes, and according to the world health organization (WTO), it is the second cause of referral to health centers by 2020 (80, 81). Findings of a study showed that music therapy can be used as a way to reduce the severity of depression in the elderly, and the impact of these interventions can vary between two genders; also this difference can be seen in reducing the sense of loneliness). Findings of another study suggest that music therapy can be used as a cost-effective and affordable way to increase cheerfulness, improve quality of life, and reduce depression in women with depression (83). The results of a study show that music therapy can improve the mental status of people with depression disorder (84). One study found that group music therapy improves depression in patients with dementia (85). In a study, music therapy has been shown to reduce the severity of depression in patients with depression disorder (86). Music therapy reduces anxiety and improves functional status in depressed patients (87). The results of another study showed that music therapy is effective in the treatment based on the depressed patients' admission and commitment (88). One study showed that group music therapy improves patients with mild to moderate depression and this method also strengthens the effect of psychological treatments (89). Music through endogenous opioids improves the positive and negative emotions of individuals (90). In a study comparing the effect of music on the

excitement of depressed and non-depressed subjects, it has been shown that music in depressed people has a greater effect on positive emotions than normal people (91).

Music and schizophrenia

Schizophrenia, with a prevalence of about one percent in the global community, usually appears at a young age (before the age of 25) and lasts until the end of life, and since drugs for this disease have several side effects, the use of non-pharmacological treatments such as music therapy is recommended, so that the use of music reduces the pathological effects of schizophrenia (92). In a study, musical activity has been shown to enhance the memory of schizophrenic patients, but for more impressive effects, side interventions are also required (93). The results of Khalaf Beigi *et al.*'s studies in 2003 showed that Mozart music and rhythmic movements increase the memory scores and attention of people with schizophrenia disorder (94). Considering that in schizophrenic patients the analysis and brain disorders, are observed, especially in the mid part of the temporal lobe, and studies have shown that the music causes neural flexibility in the brain, in particular the temporal lobe (95), thus music can improve cognitive disorder and other symptoms of schizophrenia.

Music and autism disease

A study has shown that music therapy improves the verbal and nonverbal social communication of autistic children (96, 97). It also shows that music therapy reduces self-harm behavior in autistic children (98). Music therapy along with game therapy increases the social behavior of children with autism and reduces their stereotypical behavior. Therefore, it can be concluded that the combination of music therapy with game therapy should be one of the main pillars for professionals and educators in the education and treatment of children with autism disorder (99). The emotional evacuation instigated by listening to music decreases the frequency and severity of stereotypical behaviors in autistic individuals (100). Many of the behavioral problems of children with autism disorder are due to the dysfunction in mirror neurons, and music therapy by activating these neurons in the brain can improve and reduce the problems of these children (101). A study found that the use of music in the classroom of autistic students helps them in learning and training (102). A study indicated that music therapy has a positive effect on learning social skills and improving the emotional and cognitive impairments of individuals with autism (103). In another study, music was shown to enhance brain functions and reduce the stereotypical movements of children with autism (104). It was also shown that group music therapy improves the social interactions of patients with autism disorder (105).

Conclusion

Essentially, compositions of notes, namely melodic processing, occur in the inner regions and around the auditory cortex and motor areas, while the more complex patterns of these distributed network components are analyzed in the anterior temporal lobe and frontal areas. According to numerous evidence, the right hemisphere is involved in melody processing and the left hemisphere in rhythm processing. The forehead region is among the regions associated with the auditory cortex in music processing that interferes with the shape and interpretation of memory. Over the past years, neurological studies have shown that music is a valuable tool for stimulating emotions (106), therefore in various studies the effects of music have been studied. In the field of psychology, music is regarded as a language, as common as other spoken languages of the world, which has its own specific regions in the brain; and understanding music, the same as language, needs education. Thus, music holds communicative functions such as language, as there are certain musical regions in the brain that are activated through musical sounds and

display their functions (107). Regarding what was mentioned in this article, it can be concluded that music can have positive effects on pain relief, sleep disorders, learning, memory, IQ, depression, anxiety and special diseases such as schizophrenia and autism. With the recognition of musical impacts and inspirations, a way can hopefully be opened to the practical applications of music in different fields.

Ethical issues

Not applicable.

Authors' contributions

All authors equally contributed to the writing and revision of this paper.

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