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Impact of Music On Health And Disease: With Special Reference To Neurodegenerative Ailments

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Abstract

Learning and memory problem are in general have been found with some individuals but becomes profound with aging. Three neurodegenerative diseases, like Alzheimer's disease (AD), Parkinson's disease (PD), and Huntington's disease (HD) are known where cognitive disorder and motor disorders, respectively are noticed. Till date there are no such cure of those diseases, and depend on symptomatic treatment only. Therefore, any alternative approach that can slowdown the disease progression and/or can bring some sorts of comforts to the affected people, should be counted.

The body, mind and conscience are the three components of human beings in which music is integrated. When learning music, the mind needs a lot of concentration to recognize a particular frequency. Each musical note has a specific frequency and wavelength. Here we are reviewing the impact of music, if any, on AD/PD. AD and PD, not only deteriorate the quality of life but also may cause death. Therefore, any information on any positive impact of non-pharmacological interventions, such as music, would be beneficial to public health.

Keywords: Alzheimer's Disease, Parkinson's Disease, Neural Cells, Dopamine, Neurodegeneration, Music, Raga.

Abbreviations: AD: Alzheimer's disease, PD: Parkinson's disease, BDNF: Brain-derived neurotropic factor, GDNF: Glial cell-derived neural factor, NGF: Nerve growth factor, SN: Substantia nigra, Aβ : Amyloid beta protein, SNCA: Synuclein-alpha, HPA: Hypothalamic-pituitary-adrenal, CNS: Central nervous system

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Introduction

Aging is a normal physiological process accompanied by cognitive disorder, associated with Alzheimer's disease (AD), and also cause other neuro-degeneration as have been found in Parkinson's (PD) and Huntington's disease (HD) [1]. Neurotrophins, like Brain-derived neurotropic factor (BDNF); Glial cell-derived neural factor (GDNF), are important for the survival and regeneration of some neuronal cells in the brain. Depletion of these factors in the brain are linked with the above neurodegenerative diseases [2]. Neural cell replacement strategies, therefore, are considered as a potential therapeutics for PD, AD, and HD [3, 4]. AD is characterized by an irreversible memory loss, and ultimately develops cognitive impairment and dementia, among the elderly people [5]; while PD is mainly affects motor functioning dopaminergic neurons located at the brain region, *Substantia nigra pars compacta* (SN) [6]. Typically, HD is an inherited condition in which nerve cells in the brain break down over time, generally starts at the 30's or 40's age range, and results movement disorder, cognitive, and psychological symptoms, etc. [7]. Though no curative measurements are there for HD, but some palliative drugs, talk therapy, and physiotherapy help to manage some of their symptoms [7]. AD patients generally suffer from forgetfulness to gradual irreversible memory loss, and often cannot recognize or identify their own house or belongings and closed fellows. The PD patients suffer from slow movement, difficult postures, and memory loss too, in the long run. The worldwide number of PD, AD and HD cases are growing substantially every year due to the lack of cure [8-10].

The molecular pathogenesis of both the diseases, AD/PD involves proteinopathy (abnormal accumulation of misfolded proteins), mitochondrial dysfunction and oxidative stress. In case of AD, the amyloid beta (Aβ) protein is aggregated, while misfolding and aggregation of α-synuclein have been found in PD [11]. Low dopamine secretion in the brain causes the motor neuron defects, and that eventually develop dementia in human. HD is a genetic disease, the mutated *Huntingtin protein* develops clumps in the brain cells, that causes damage and ultimately death of the cells. Any damage to the striatum of the brain which controls movement, memory and mood, may develop the symptoms of HD over time. [12].

The therapies of AD/PD/HD are available, so far, only symptomatic, and unable to cure or prevent the progression of the diseases. In this scenario, some different types of management of the diseases will be appreciated which can at least improve patient's quality of life. Regular Exercise, Healthy Diet, Mental Stimulation, Good Sleep, Stress Management through music, etc. are therefore recommended, and of course family and/or community support are essential. We will be restricting our discussion in this article only to the musical influences, if any, on the said ailments.

Music and AD/PD

The study by Thoma et. al (2013) examined the effects of music on human stress response in different systems, like endocrine, autonomic, emotional and cognitive impairment [13], and suggested that listening to music can affect the autonomic nervous system, and also to the endocrine and psychological stress response.

Later on, in 2013, Witter, Webster & Hill's determined the alteration of spatiotemporal gait velocity which is decreased by rhythmic music and metronome cues in Alzheimer patients [14]. It, therefore, appears that rhythmic auditory cueing at comfortable speed produced deleterious effects on gait in Alzheimer patient. Some researchers also found that music helped to lead improved balance, greater ability to perform activities of daily living, and improved life satisfaction among elderly individuals [15]. Some of the music effects are found in the middle part of the brain that have connections to emotions. Similarly, music is not only considered as a powerful form of entertainment, creating a fun, upbeat atmosphere, also helps at retaining memories, and stimulates critical thinking [16, 17].

Toning up the muscles and mood: It was shown that music therapy can lessen tremors and slow movements, associated with PD [18-22]. People with Parkinson's when walking with music can walk faster, take bigger steps, and showed better overall balance, compared to those who were walking without music [23]. With this firsthand experience there is no doubt that music can elevate mood, and lessen depression often experienced by people with Parkinson's.

Indian Music

Any music has the power to soothe the mind. Music therapy is able to keep the heart rate and blood pressure normal and also relaxes the mind. Indian music with its emotion on mind fosters a therapeutic effect to the sick,

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in particular. Although, music therapy clinically is not very widely practiced, but its healing effects have been known to all from a long time back.

Healing power of Indian Music in Neuro-degenerative diseases: Cognition affects emotion, and emotion monitors behavior of an individual. Indian music has the capability of arousing different forms of emotion and that is why people could connect with music.

The "rasa" or essence that musicians and audience experiences in Indian music has a psychological basis. It is a form of aesthetics that is achieved in the highest form of cognition. Further, there is a fantasy music for relaxation, movement music to get rid of depression, and resolution music that enhances confidence. When learning music, the mind needs a lot of concentration to recognize a particular frequency. Each musical note has a specific frequency and wavelength [24-27].

Besides its therapeutic effects, music helps to improve general quality of life. Music combined with movement, like aerobic exercises or gym improve physical capabilities and reduces weight issues. Singing helps in maintaining healthy lungs. Music is found to alleviate depression by providing new aesthetic experiences. Music can enhance communication and expressive skills and helps in social skills among patients suffering from schizophrenia and related disorders [28-30].

Discussion

A: Important factors that should be considered for neurodegenerative disease-

1) Dopamine: Dopamine releases during happiness. Scanty level of Dopamine in the brain develops PD, as well as can increase the risk of developing Alzheimer's Disease, too (www.RajivBahlMD.com). MRI scanning of the brain revealed a low level of dopamine in the hippocampus region of the Alzheimer patient.

2) BDNF/GDNF: BDNF and GDNF proteins have been the focus of interest neurodegenerative disease, like AD/PD for a number of years. They improve the survival length of cholinergic neurons as well as Dopaminergic neurons, and their functions at the basal forebrain and at hippocampus region, respectively [31-33].

B: Effect of music on the above vital factors related to neurodegenerative diseases.

The biological determinants of music are largely unknown, however according to a new study, the activity of genes responsible for dopamine secretion, synaptic neurotransmission, learning and memory are activated by listening to classical music [34]. Further, the above system can also down-regulate the genes causes the neurodegeneration [35, 36]. One of the most up-regulated genes, synuclein-alpha (SNCA) is a known risk gene for Parkinson's disease that is located in the strongest linkage region of musical aptitude. These findings gave us a new molecular mechanism underlying the music therapy [35, 36].

It was known that music has physiological effects on cardiac heartbeat, respiration, blood pressure. Further, music also can improve the mood disorders affected by anxiety, depression and other psychiatric reasons. However, the biochemical reasons of these phenomena are unknown yet. Hypothalamus region of the human brain is involved in maintaining the body homeostasis. The modulation of hypothalamic-pituitary-adrenal (HPA) axis develops the pathophysiology of anxiety and depression. The BDNF and the nerve growth factor (NGF), are involved in maintaining the growth, survival and function of neurons in the central nervous system (CNS). These neurotrophin factors are also involved in influencing the hypothalamic functions. In another study with mice it was shown that the music exposure can positively affect the level of BDNF and NGF in hypothalamic region [37].

Conclusion

Aging is a normal physiological process accompanied by cognitive decline, a major symptom of AD. Cognitive deficit is associated with low levels of neurotrophic factors such as BDNF, GDNF, and NGF. These neurotrophins are important for the maintenance, survival, and regeneration of neural cells in the human brain. Therefore, cell replacement strategies are being thought as potential therapeutics for neurodegenerative diseases like Alzheimer's, Parkinson's, and Huntington's diseases [3].

Listening or playing Music is common to all societies. Music not only brings pleasure to mind, but also at the biochemical level it enhances the production Dopamine and BDNF/GDNF to counteract the PD/AD symptoms, both.

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Conflict of Interests

Both the authors have contributed equally to prepare this article, and approved for submission of the final manuscript thus there is no conflict of interests.

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