

The Efficacy of Employing Music-Based Interventions to Manage Neurodegenerative Diseases: A Systematic Review of Music Therapy as a Nonpharmacological Method

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ABSTRACT

Among the diseases with no cure lies neurodegenerative diseases, a group of disorders that result from progressive damage to cells and nervous system structures and connections that are essential for mobility, coordination, sensation, cognition, and strength. Research on ways to manage Neurodegenerative Diseases (NDDs) is increasing in its pivotal nature in the modern realm of medicine, because to this date there is no widespread cure for them. This paper assesses the efficacy of using music-based interventions (MBIs) to manage these NDDs. In addition, after reviewing multiple articles, this research paper highlights a systematic review of Music Therapy (MT) when employed as a nonpharmacological method. These articles are based on relevant topics, which are included as a review of related literature. To make the data visually easier to read, a table was constructed, and visual information, including images, was incorporated. The primary method for going about this research problem was interviewing a Music Therapist. The interview provided extremely valuable insight from an expert who frequently witnesses the implementation of MBIs to better the quality of life for dementia patients. This includes using music therapy to manage their NDDs. From the primary themes analyzed from the music therapist's responses, the researcher concludes that music therapy is extremely efficient in managing dementia and other such NDDs, as well as, its increasing popularity, relevance, and practicality. However, additional research needs to be conducted on this subject. Additional studies and tests of other non-pharmacological methods and other specific types of music-based interventions are recommended in order to explore this topic further.

Introduction

More than fifty million people world-wide are suffering with neurodegenerative diseases, conditions that eventually destroy parts of your nervous system. The stage where one feels a decline in memory, thinking, and social capabilities refers to a condition known as dementia. Some of the most common types of neurodegenerative diseases and dementia include Alzheimer's Disease, Parkinson's Disease, and Huntington's Disease. A certain statistics from Fisher Center for Alzheimer's (2024) states that every 65 seconds, one person in the US develops Alzheimer's Disease. This is just one example to show the intensity of these neurodegenerative diseases. Even though numerous people are suffering from this disease, to this date there is still no definite cure for any of these diseases. Therefore, researchers are trying to look into various means to find a solution to alleviate this suffering. So it is pertinent to look for other methods to manage dementia. With this current heightening demand, this paper serves as a review on the efficacy of music-based interventions on neurodegenerative diseases.

According to Harvard Medical School Publishing, a study in Japan shows how music helps restore memories. Additionally, in the study, some elderly people did a little better on memory tests once they listened

to music (Fabiny, 2015). The increasing possibility of employing music to increase memory in dementia patients is recognized by many organizations as well. For instance, the Music and Memory Organization educates many people about these findings and directly helps patients. With this international study and specific organization, it is evident that music-based interventions have positive impacts on neurodegenerative diseased patients.

According to the National Library of Medicine, music-based interventions (MBIs) represent two categories. These are music therapy and music medicine, which are both slightly different. Music therapy usually includes a professional therapist, but music medicine is more about using music as medicine. This national source also suggests that music engages many different areas of the brain and strengthens the complex networks of the brain involved in motor processes, memory, and emotions (Edwards et al., 2023). Moreover, when music can provide these great benefits, when intervening in treatments for various neurodegenerative diseases, it can show those benefits as well.

Specifically focusing on interventions with music therapy, there is an organization in North Carolina that provides support to these claims. According to the Music Therapy Association of North Carolina, music therapy helps address individuals' social, physical, emotional, and sensory needs. Each of these areas are controlled by different parts of the brain. For instance, emotion is primarily regulated by the frontal lobe. Therefore, with strengthening these various parts of the brain, music therapy is inevitably alleviating neurodegenerative diseases and disorders.

Ever since the researcher was three and a half years old, she has been passionately singing and playing multiple instruments. With this unique connection to music, she was eager to explore how efficient music could be when used in a clinical setting. Expanding her interests further, the researcher wanted to research music-based intervention and its effects on neurodegenerative diseases. This study could provide promising results in the future of the neuroscience medical field by sharing alternative techniques that could manage and alleviate these life-threatening diseases with no definite cures.

Methodology

In order to further understand the impacts and efficacy of music-based interventions on neurodegenerative diseases, the researcher wanted to conduct an interview with a music therapist who could talk about his or her experiences with how MBIs can impact patients. In this study that the researcher conducted, the researcher met online via phone call with these respondents.

The researcher chose Trellis Supportive Care as the organization where the virtual study was done. The reason is because this organization had many dementia patients and patients with other neurodegenerative diseases as well. The participant of the study consented for the researcher to record responses and include them in this research paper, without revealing his or her identity (name, phone number, etc.).

Additionally, it is important to note that the researcher made her own interview questions which were reviewed by Professor Virgel.

Anatomical Brain Tracking on the Effects of MBIs

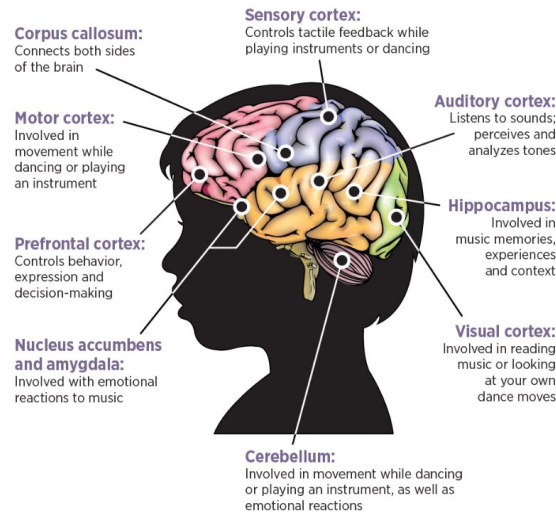


Figure 1. Music Touches Many Areas of the Brain. As seen in this figure, different parts of the brain synthesizes different neurological movements. The reaction to a familiar song could provide an Alzheimer's patient with a movement shown in the motor cortex. MBIs can help strengthen these various parts of the brain, thus alleviating neurodegenerative disorders. When a patient is intervened with MBIs, different parts of the brain are activated at different times. Sound Health at the Kennedy Center (Psychology Today).

First, the patient must hear the music. Anatomically, this represents the auditory cortex, which further perceives and analyzes the tones. Next, the hippocampus recognizes these music memories and realizes his/her particular experiences. Then, the nucleus accumbens and amygdala are involved with emotional reactions to music. These emotions lead to particular responses, like for instance dancing to the music. This behavior is controlled by the prefrontal cortex. Lastly, the response to the MBIs leads to the patient finally responding with a movement. This movement is controlled by the motor cortex.

Dancer's Memory - Incorporating Effects of MBIs



Figure 2. The stunning moment a ballerina with Alzheimer’s dances ‘Swan Lake’. According to an article published in the New York Post (Sparks, 2020), an Alzheimer’s patient recalls memories of her as a former ballet dancer who performed to the song ‘Swan Lake’ through her various movements in reaction to the song. These are illustrated in the video attached to the article. Moreover, the patient goes through the previously detailed stages of anatomical brain tracking to music. When the patient first started to hear the music, she urges the music therapist to increase the volume. Article Source: New York Post (Sparks, 2020), Video Source: <https://youtu.be/owb1uWDg3QM?feature=shared>

However, just a few seconds later she pushed his hand away, grieving for her loss of memory to recall the song. In response, the music therapist encourages her to listen further to the song. To the viewer’s dismay, the former ballerine Marta C. Gonzalez immediately picks up on the song and starts to sway her arms with the movement she performed many years back. It was almost as if her brain was amazed at the movements of her arms – a moment of reflex. On an anatomical level, her auditory cortex is the first to respond since it perceives and analyzes the tones.

Next, the hippocampus recognizes these music memories and recalls the particular experience during the specific event that took place (in this case the primera ballet dance where Marta performed prior to when she had Alzheimer’s). Then, the nucleus accumbens and amygdala are involved with emotional reactions to music. These emotions were associated with her powerful dancing to the music. After listening to the music, Marta C. Gonzalez first states, “Me emociona”, which translates to “I am excited/emocional”. This behavior is controlled by the prefrontal cortex. Lastly, the response to the MBIs leads to the patient finally responding with a movement, which is controlled by the motor cortex.

The Type of Music Employed During MBIs

Dr. Oliver Sacks, M.D., is a notable neurologist and best-selling author of *Musicophilia*. His book details the impact of personalized music for Alzheimer’s patients and others with severe memory loss. “The past which is not recoverable in any other way is embedded, as if in amber, in the music, and people can regain a sense of identity.” — Oliver Sacks

Dr. Sacks emphasizes the employment of personalized music rather than any piece of music throughout his book and writings. Moreover, he believes that the particular type of music that the patient reacts to and interacts with should be that which can be relatable in some event. For instance, the previous example of ‘Swan Lake’ had a connection to the patient, since Marta C. Gonzalez was an accomplished ballerina.

To provide another instance, the American Music Therapy Association (AMTA) also asserts this claim. According to the AMTA, “A qualified music therapist will consider your or your loved one’s preferences, circumstances, and treatment goals when deciding which music to include as part of therapy.” In summary, the type of music played during MBIs is extremely important, because it will give patients a closer relation and connection to that particular music piece played.

The Impact of MBIs in California Nursing Homes

A study conducted in 2020 led researchers from the Betty Irene Moore School of Nursing at UC Davis to find that personalized music causes a reduction in the amount of antipsychotic medication taken by residents of the nursing home. Another effect of employing MBIs was significantly fewer distressed behaviors (Music and Memory, 2023).

This comprehensive study lasted for three years and included 4,107 residents in a total of 265 California nursing homes. The results were that the researchers found that the use of antipsychotic drugs declined by

thirteen percent and anti-anxiety medications declined by seventeen percent each quarter for residents with dementia using MBIs. Moreover, the chances of depressive symptoms expressed by the residents decreased by sixteen percent per quarter, while the odds of reporting pain also decreased by seventeen percent per quarter. In addition, the number of days the patients were on medications declined by about 30 percent and aggressive behaviors reduced by 20 percent (Bakerjian, 2020).

According to the *Journal of Post-Acute and Long-Term Care Medicine* (JAMDA), this study is the largest study of music and memory and the implication of MBIs to this date. The table below summarizes the results of the study conducted by UC Davis in a coherent fashion.

Condition	Measure of Change
Use of Antipsychotic Drugs	Declined by thirteen percent (13%)
Use of Anti-anxiety Medications	Declined by seventeen percent (17%)
Odds of Depressive Symptoms	Declined by sixteen percent (16%)
Odds of Reporting Pain	Declined by seventeen percent (17%)
The Number of Days the Patients were on Medications	Declined by thirty percent (30%)
Aggressive Behaviors	Declined by twenty percent (20%)

Image Source: Diya Patel, Data Source: *Journal of Post-Acute and Long-Term Care Medicine*

Music Activates Regions of the Brain Spared by Alzheimer’s

A study conducted in April 2018 by the University of Utah Health in Salt Lake City, reports that “Objective evidence from brain imaging shows personally meaningful music is an alternative route for communicating with patients who have Alzheimer’s disease.” (Foster, 2018)

The research published by the University of Utah Health team in *The Journal of Prevention of Alzheimer’s Disease*, details how familiar music may facilitate attention and motivation. This in turn makes it more possible to manage emotional distress in Alzheimer’s.

According to Jeff Anderson, M.D., PhD, associate professor in Radiology at the University of Utah Health and contributing author to the study, “People with dementia are confronted by a world that is unfamiliar to them, which causes disorientation and anxiety. We believe music will tap into the salience network of the brain that is still relatively functioning.”

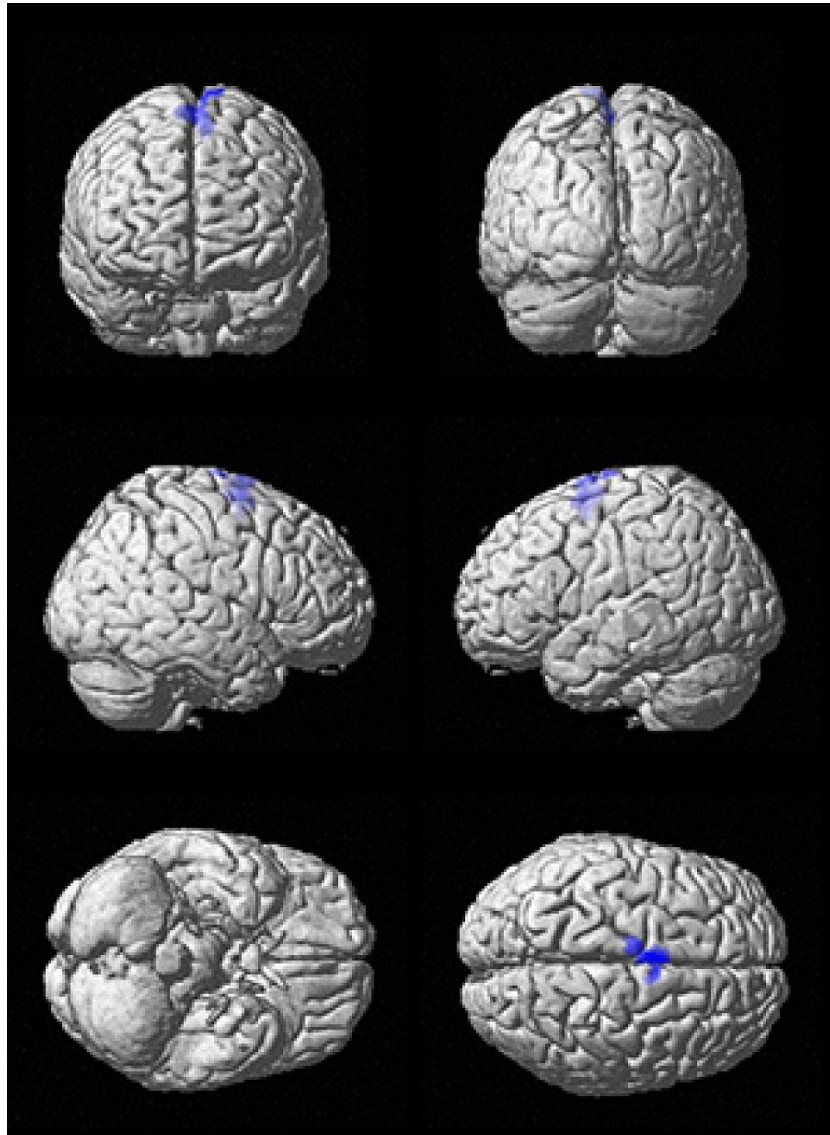


Figure 3. The Shaded Areas Were Activated by Familiar Music. In the same study detailed previously, Jace King, a graduate student in the Brain Networking Lab says, “Music is like an anchor, grounding the patient back in reality.” These images were taken using a functional MRI, where researchers scanned the patients to image the various regions of the brain that lit up when the patients listened to twenty-second clips of music, as opposed to silence. The researchers played eight clips of music from the patient’s music collection, followed by eight more clips of the same music played in reverse and eight blocks of silence. Source: (University of Utah Health, 2018)

The researchers then compared the different images from each scan. They found that music does indeed activate the brain, causing whole regions of the brain to communicate. By listening to their personal soundtrack, multiple network pairs all showed higher functional connectivity. These network pairs include, but are not limited to, the visual network, the salience network, the executive network, the corticocerebellar network and the cerebellar network.

MBIs and Improved Swallowing in Patients with Advanced Dementia

Swallowing and choking issues affect many people with advanced dementia. These symptoms can lead to serious health issues such as dehydration, malnutrition, and weight loss. The 2018 study was published with the conjunction of Dr. Stephen Post of Stony Brook University and is detailed in the *International Journal of Social Research and Practice*.

Dysphagia refers to the difficulty of swallowing. In addition, difficulty of eating also affects many individuals with advanced dementia. According to the same study, 86 percent of the 323 patients with dementia had feeding problems. This study also exhibited evidence that musical intervention during mealtime decreased aggression, confusion, depression, and anxiety, which may help to improve weight gain and nutritional status (Whear et al., 2014). Additionally, music interventions make eating easier and potentially could diminish reliance on feeding tubes and PEG (percutaneous endoscopic gastrostomy) intervention. The detailed results are described below.

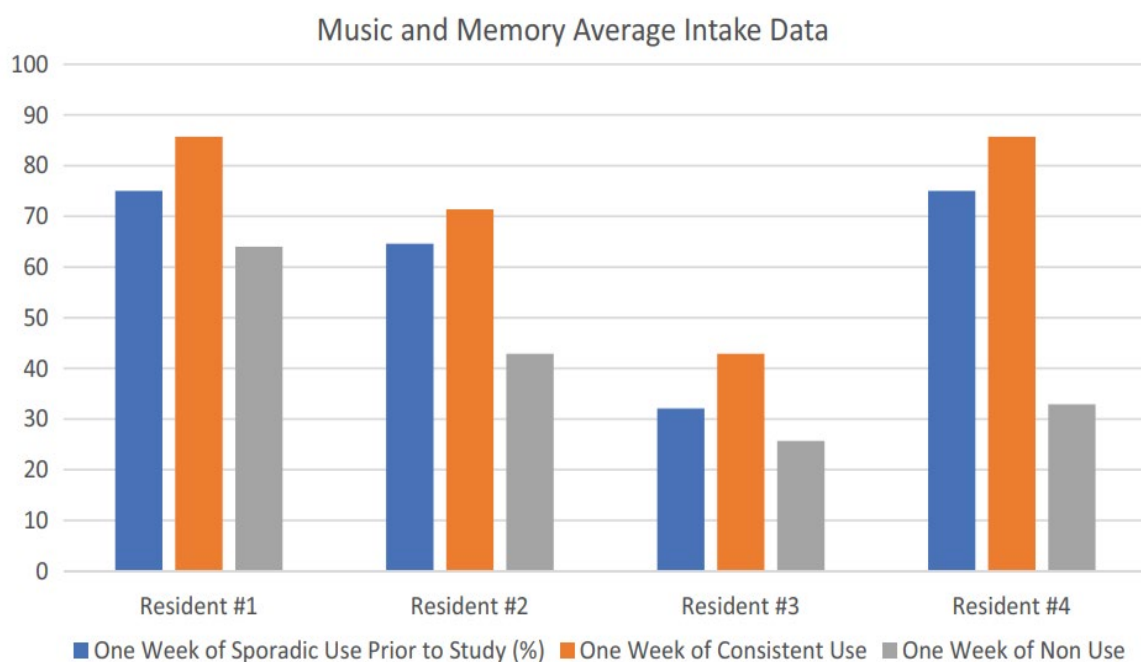


Figure 4. Music and Memory Average Intake Data. Source: (Cohen et al., 2018)

There are various conclusions the researchers from Stony Brook University drew. The researchers note that, “While no significant control group was employed in this research design, data collection was recorded in the absence of the intervention and incorporated within the comparison of the study.” The below table shows the conclusions which can be drawn from the data from Figure 4.

Conclusions From the Data (Graph)
1. Enhanced swallowing mechanism with Music & Memory prior to dining

2. Decreased incidents of choking during mealtime
3. Improved nutrition status
4. Reduced weight loss/maintenance of weight
5. Reduced need for speech interventions/thickened liquids
6. Enhanced quality of life/aging in place status

Image Source: Diya Patel, Data Source: *International Journal of Social Research and Practice*

MBIs for Acute Neuropsychiatric Symptoms in Adults with Cognitive Impairment

Neuropsychiatric Symptoms are common symptoms of dementia. These features occur in about seventy-five percent of patients on psychogeriatric inpatient units. Moreover, these symptoms have traditionally been treated with pharmacological agents. The problem with these medications are that they are as likely to harm the patients with dementia as they are to help them.

As a result, non pharmacological interventions are being investigated increasingly as ways to alleviate these symptoms. The study published by the University of Kansas School of Medicine in 2018 concludes that agitation, negative mood, and positive mood are all benefited from the music-based intervention (MBI). These findings suggest that an easily implemented and reproducible MBI, which is well tolerated and lacking adverse side effects, can be an effective way to reduce neuropsychiatric symptoms associated with dementia in a hospital unit. The findings are elaborated on with the below Figure 5.

Variable	Tx as usual	Music
Agitation measures		
Aberrant vocalizations	0.85	0.20
Requests for help	0.74	0.53
Verbal aggression	0.54	0.13
Motor agitation	0.89	0.47
Physical aggression toward others	0.49	0.00
Physical aggression toward self	0.41	0.00

Resisting care measures		
Resisting medications	0.48	0.40
Resisting eating	0.33	0.22
Resisting bathing	0.07	0.00
Resisting toileting	0.62	0.00
Resisting dressing	0.62	0.03
Resisting sleeping	0.48	0.16
Negative mood measures		
Tearful	0.11	0.10
Withdrawn	0.94	0.67
Appears sad	1.06	0.78
Appears anxious or worried	1.00	0.67
Irritable or short tempered	1.07	0.45
Lacks sense of enjoyment	1.08	0.68
Lacks energy or fatigued	0.46	0.39
Positive mood measures		
Smiles	1.11	1.48
Appears happy	1.08	1.50
Expresses positive emotions	1.00	1.44
Appears to enjoy activities	1.00	1.60
Interactions positively	1.14	1.84
Has appropriate energy	1.55	1.91
Easygoing and agreeable	1.36	1.79

Figure 5. Sample Median Rating for Each Behavior as Averaged Across the Course of Hospitalization. This data table shows impacts of MBIs in various measures. After a thorough examination of the data from all the categories in this data table, one could assert that the statistics show all positive impacts of MBIs. The various categories present in this table include: agitation measures, resisting care measures, positive mood measures,

and lastly negative mood measures. All in all, this statistical data also shows how music-based interventions can help alleviate some of the neuropsychiatric symptoms which are common in patients with dementia.

Note. Tx as usual = treatment as usual group; music = music-based intervention group.

Source: (Schroeder et al., 2018)

Music Interventions to Prevent Delirium Among Older Patients Admitted to a Trauma Intensive Care Unit and a Trauma Orthopedic Unit

The onset of delirium poses a serious health risk for older patients. The study was randomized and controlled and consisted of forty patients aged 55 years and older. The primary researcher was Dr. Kari Johnson, PhD, RN, ACS-BC with Honor Health in Scottsdale, Arizona. Dr. Johnson tested the effect of self-selected music playlists (which were pre-recorded) on trauma patients' vital signs and possible confusions.

In the music intervention group, there was a significant reduction in heart rate (HR) and systolic blood pressure (BP). In the control group, however, there was no change in the HR or BP. Therefore, this indicates that the intervention had helped to reduce the anxiety of patients – a major precursor to the onset of delirium (Johnson, 2018).

Individualized Music Program is Associated with Improved Outcomes for U.S. Nursing Home Residents with Dementia

A particular study, conducted in 2017 by Brown University, compares psychological and behavioral resident outcomes before and after implementation of MBIs (like the Music and Memory program). They have published their findings in *The American Journal of Geriatric Psychiatry*.

The study involves ninety-eight nursing homes trained in Music & Memory and ninety-eight comparison facilities (used as a control group). The results show that the discontinuation of antipsychotic medications increased in Music & Memory facilities.

Facilities using Music & Memory also demonstrated increased rates of reduction in behavioral problems versus comparison facilities. Implication for practice concluded that “effective, non-medicalized, low-cost interventions such as Music & Memory, are critical to address the needs of the growing population.” (Thomas, 2017) The following table illustrates the exact change in increased or decreased quantities of specific behaviors.

Behavior Analyzed	Initial Percent in Music & Memory Facilities	New Percent in Music & Memory Facilities	Initial Percent in Comparison Facilities	New Percent in Comparison Facilities
Discontinuation of Antipsychotic Medications	23.5 %	24.4 %	24.8 %	20.0 %
Reduction in Behavioral Problems	50.9 %	56.5 %	55.8 %	55.9 %

Image Source: Diya Patel, Data Source: *The American Journal of Geriatric Psychiatry*

Results and Discussion

This section presents the results and discussions based on the research questions formulated by the researcher. Moreover, a detailed discussion of the results in relation to the recent literature are presented below.

Impact of Music Therapy on the Neurological Aspects of the Brain

In analyzing the impact of music therapy on the neurological aspects of the brain, the research participant shared her working experience with patients who have dementia, Alzheimer's, Parkinson's and strokes. The participant highlights the importance of music in calming the senses of the patients who are experiencing agitation or anxiety due to their conditions. Moreover, music has a positive impact on these patients despite their confusion and lack of awareness in their environment:

Music Therapist:

I work with people all the time who have diagnoses of dementia, vascular dementia, Alzheimer's, Parkinson's, and Stroke patients. I've had several who I didn't even think could talk and I hadn't even heard them say a word. And then I start to sing songs that their spouse, son, or daughter told me was special or meaningful. Then they would perk up and sing along, even, sometimes. And, you can just see it in their eyes that they recognize what is going on, even though when you talk with them they are continuously confused and have no idea on what is going on. I have also seen it with people who are agitated or anxious because of these neurological conditions. Music can be such a cool tool to kind of center them and ground them and bring them back to a healthier state. Being agitated and anxious is not good for us, it is especially not good for them.

Likely Results of Music Therapy Introduction on Dementia Patients

When considering the likely results of music therapy on dementia patients, the research participant shared her care plan and clinical documentation goals. The participant highlights the use of music as a tool of connection. Moreover, music gives beautiful moments of connection even to the patients who are easily drawn into their own confusions and isolations:

Music Therapist:

I work in end-of-life care, so these patients, often, especially if this is their primary diagnosis they are very far progressed into this disease. We cannot reverse the damage that has been done already to their bodies, but we can improve their quality of life. To give you an idea of my clinical documentation, my goal for the care plan for somebody with a neurological disorder might be multi-sensory stimulation, four meaningful interactions, and quality of life. And so in these visits, my goal is to bring in music that has been meaningful to them or that they recognize, and use it as a tool to connect with them interpersonally, because especially people in memory care units, it is really easy for them to draw into their own world and confusion and isolate themselves. And so, bringing them out and giving them these beautiful moments of connection is really important and kind of plays a role in improving their quality of life.

Personal Experiences About the Impact of MBIs on Neurodegenerative Diseases

In analyzing the personal experiences of the research participant when witnessing the impact of MBIs on Neurodegenerative Diseases, she shared her first-hand experiences including an extremely anxious lady with unspecified dementia. The participant highlights the importance of music in calming these anxieties and relieving their inconsolable states of nature. Furthermore, music has a unique wonderful influence on these patients, making them calmer, more consolable, and by slowing down their breathing:

Music Therapist:

Just to give you an example, I work with one lady with unspecified dementia, but she is just incredibly anxious. Every time I have gone to see her recently, she is just basically inconsolable, calling out for “HELP!” telling me that she needs to go see her mother and it’s safe to assume that her mother is no longer alive. But when I start to talk to her about music, she will kind of just stop calling out for help and she will calm down and for a while she will be easily distracted by the ocean drum and her breathing would slow down, her affect would change, and her tone of voice would change. It’s like you know when somebody is upset. You can tell. And when you’re bringing this music in, a lot of the time, it does wonders to kind of alleviate that.

What Makes Music Therapy So Powerful?

When probed about what makes music therapy so powerful, the research participant shared her thoughts on this unique tool. The participant highlights the importance of recognizing the origins of music – which has almost been here since the dawn of time. The music therapist wraps up her response with positive signs of music therapy:

Music Therapist:

Well first of all music is just such a unique thing. It’s hard to even put into words right, it’s something that is almost universal. Like we know cultures all over the world have incorporated music into culture since the dawn of time. That has just been something that we as humans have always been drawn to, to do. And music acts as a sort of connection. It’s used as a method of worship for different religions. It’s used as a tool for expression or enjoyment – or even creativity. And so in that connecting tool, I think of music as that gateway into a relationship with somebody. There is an inherent connection with people as you are playing. You kind of tune into one another and follow the same beat and tempo. And I think that that connection gives you a really cool opportunity to build a relationship that can then work towards these different goals in therapy. Whether those are neurological goals or emotional processing, music therapy as a whole just holds a really good space for that.

Closing Thoughts on Impacts of MBIs like Employing MT as a Non-Pharmacological Method

In closing the discussion, the researcher would like to include some of the research participant’s closing thoughts on the impacts of MBIs, especially when employing MT as a non-pharmacological method. The music therapist emphasizes the quality of MBIs and MT to improve the patient’s quality of life. In conclusion, music has an extremely positive impact on NDD patients while managing their dementias and qualities of life:

Music Therapist:

Specifically thinking about people in nursing facilities and skilled nursing who are significantly impaired by these diseases socially, mentally, like they don’t even recognize their own children, I think that improving their quality of life is just so important. And often I feel like they are forgotten people. You know, if you walk into a nursing home, not many people like being there, and so being able to give them a little bit of a connection with the life that they had before, a moment where it might trigger a memory or it might give them peace or comfort – I think that is just so valuable and it something I really love to do.

Closing Summary

Overall, one of the themes in these above responses is that music therapy allows a patient to recognize their

surroundings and sing along, in some cases. Moreover, allowing the patients to have meaningful connection to the world around them allows for less agitation and a better quality of life. One of the most emphasized themes in the responses is using music therapy as a powerful tool to recover memories using music-based intervention (MBI). Music is really just a source of communication and a tool for expression. Continuing on, music opens gateways to relationships and provides a source of creativity. All in all, MBIs are shown to improve the patient's quality of life through these specific benefits and impacts.

Conclusions and Recommendations

These results underscore the effective nature of MBIs in regards to managing dementia. Additionally, employing music therapy as a nonpharmacological method is practical, successful, and relevant in the modern realm of medicine. The most important finding of this topic is how using music can bridge the gap between a neurodegenerative disease patient and their memories about the world around them. Moreover, MBIs can provide meaningful and powerful tools through which patients can connect with the world. The findings of this study should be implemented throughout the world by sharing its positive benefits to help medicine and patients all over the world. It is recommended to spread awareness about this impressive finding and encourage global uses of MBIs and MT to manage these dementia symptoms and improve the quality of life for numerous patients around the world.

The limitation of this study is that it was conducted in a virtual setting. In the future, additional research needs to be conducted on this subject. Additional studies and tests of other non-pharmacological methods and other specific types of music-based interventions are recommended in order to explore this topic further. Lastly, researching the feasibility of implementing these MBIs at an even earlier stage of dementia (like music experimentation) is recommended.

Acknowledgments

First and foremost, I express my gratitude to my family members for their unwavering support and encouragement in pursuing this topic. In addition, I thank Trellis Support Care for their assistance in the interview conducted with the music therapist and offering valuable insights about the effects of MBIs on dementia patients. Lastly, I am thankful to Prof. Virgel, Dr. Jobin, and Coach Jo for their guidance throughout the research process and for reviewing my paper.

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