Systematic Review Article

The Effectiveness of Music Therapy in Mitigating Autoimmune Disease Pain Perception

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ABSTRACT

Music therapy has recently gained popularity as a method of reducing anxiety, restoring cognitive functions, encouraging sedation, and alleviating pain. However, the role of music therapy in mitigating pain perception for those with autoimmune diseases has not yet been extensively, if at all, researched. This paper aims to summarize the existing evidence of the general effects of music therapy on patients, as well as to draw connections between music therapy, pain perception, and autoimmune disease in order to explore potential impacts of music therapy on autoimmune pain. A literature search was performed using various databases for papers published between 01 May 2013 and 01 August 2025. Included are studies and reviews that pertain to music therapy, autoimmune disease, pain perception, and auditory signaling in order to provide adequate background on the research topics. From the review, it is clear that music therapy has benefits for neurodegenerative diseases such as Alzheimer's and Parkinson's, effectively improving or restoring cognitive and motor functions. Music therapy also effectively reduces pre-operative anxiety and encourages deeper sedation during surgery. Moreover, music therapy and general auditory stimuli are able to alter neural patterns in the somatosensory cortex, in which pain is perceived. Autoimmune pain disorders are often caused by autoimmune attacks in these somatosensory pathways. These findings suggest that music is an effective therapy for autoimmune pain since music is able to reduce anxiety and affect neurons in the area of autoimmune attacks.

Keywords: auditory stimuli; autoimmune disease; music intervention; music therapy; pain perception

INTRODUCTION

Music therapy has been widely employed to mitigate cognitive, anxiety-related, and pain-related effects of different diseases and procedures. Autoimmune disease, however, has not been studied alongside music therapy, and there is no known cure for this group of painful inflammatory disorders that cause the body's immune system to mistakenly attack healthy tissues. In terms of neurodegenerative disease, music may affect emotions, communication, movements, and behaviors, specifically by strengthening connections between motor and auditory areas of the brain (1) (Table 1). Drawing this to pain perception, auditory stimuli have the potential to modulate neural pathways and firing within the somatosensory cortex, a location of the brain in which pain is perceived (2). Furthermore, numerous autoimmune pain disorders are caused by particular antibodies that attack antigens in that somatosensory pathway (3), suggesting a potential area of intersection between music therapy and autoimmune pain.

This review delves into music therapy and its various neurological functions, autoimmune disease and its pathologies, and methods of pain perception. These three

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Table 1. *Motor and non-motor outcomes after musical interventions in the study reviewed by Raglio et al. (1). It is demonstrated that rhythmic and other musical stimulation, including singing, free body movements, and auditory cueing using familiar songs have significant effects on numerous motor and several non-motor functions in patients of neurodegenerative disease. Motor function improvements include timing, gait, balance, stability, and speed; non-motor function improvements include mood, verbal memory, attention, calmness, and quality of life.*

Randomized Controlled Trials and Controlled Clinical Trials from PubMed database regarding Parkinson's disease, including clinical studies rehabilitative treatment in English.

Motor outcomes	Non-motor outcomes	Subjects n experimental group + n control group	Interventions/duration	Follow-up
Improving in perceptual and motor timing	Not evaluated	15 + 20	Rhythmic auditory cueing (beat + superimposed familiar songs)/4 weeks (30 min/session, 3 sessions/ week)	Yes
Improving over time in motor function, cognitive function (verbal memory, language, and executive function and attention)	Slight improvement over time quality of life	12 + 6	Ronnie Gardiner rhythm and music (music method uses music, rhythm, movements and speech)/6 weeks (1 h/session, 2 sessions/ week)	None
Improving in functional gait, balance, and freezing	Not evaluated	8 + 8	Rhythmic auditory stimulation (RAS)/6 weeks (45-60 min/ session, 3 sessions/week)	Yes
Slight improvement over time in tremor	Improving over time in mood and anxiety; modest improvement on quality of life	18 + 18	Music relaxation/4 weeks (45 min/ session, 2 sessions/week)	Yes
Significant improvement in bradykinesia	Improving over time in emotional functions, activities of daily living and quality of life	16 + 16	Music therapy sessions (choral singing, voice exercise, rhythmic and free body movements, and improvisational music therapy techniques)/3 months (2 h/session, weekly sessions)	Yes
Improving in gait parameters (velocity, stride length and step cadence)	Not evaluated	15 + 11	Rhythmic auditory stimulation (RAS) (beat + superimposed music)/3 weeks (30 min/session, daily)	None

main topics are then tied together to draw conclusions regarding the question being investigated.

LITERATURE REVIEW

To explore the potential of music therapy for auto-immune disease, the following literature review details the functions of music therapy in restoring cognitive function, relieving anxiety, and acting as a sedative.

The following section presents the utilization of music therapy in neurodegenerative diseases to form new neural connections and encourage cognitive and motor restoration. Patients with Alzheimer's disease often experience depression, apathy, and restlessness, all of which have been found to be remedied by music therapy. It contributesmemoriesproved speech fluency, mood, socialization in isolated patients, and memory of one's life (4). Additionally, in patients who listened to music, cortical atrophy (degeneration of the posterior cerebral cortex) and glucose metabolism disruption were

significantly reduced compared to patients who were not exposed to music (5). Not only does music therapy improve short-term emotional well-being (assessed by the facial scale, which utilizes facial expressions); music also demonstrates long-term effects including reduction of psychological and behavioral Alzheimer's symptoms (assessed by the Behavioral Pathology in Alzheimer's Disease Rating Scale) (6). In patients with Parkinson's disease — a neurodegenerative disease primarily affecting physical coordination — training with rhythmic musical cues can alter neural pathways in the cerebello-thalamo-cortical network, enhancing motor timing and speed (1). Those with severe symptoms of dementia and cortical atrophy may not be able to derive similar benefits from music therapy due to the level of impairment of their cognitive and motor skills. However, as a non-invasive, non-pharmacological, and cost-effective form of therapy, music is generally ideal for patients suffering with neurodegenerative disease.

The following section details the utilization of music therapy in relieving pain and anxiety and acting as a sedative. Patients entering surgery frequently experience fear, stress, hypertension, and tachycardia as a result of anxiety; music has been known to relax the mind and body, potentially offering a solution to this pre-operative issue. When patients entering stomatological (oral) surgery were exposed to music therapy before their procedure, they exhibited significant reductions in both anxiety (measured on the anxiety visual analogue scale, A-VAS) and alertness (measured using the bispectral index, BIS) from before to after the procedure, in comparison to the control groups who received the sedative midazolam rather than music therapy (7). The music therapy in question consisted of a conversation to gather patients' musical preferences, a guided relaxation and gradual slowing of the breath while focusing on an image with a positive association, and a five-minute listening session via noise-canceling headphones. Additionally, when jaw surgery patients were exposed to brain wave music — music that synchronizes with the brain's electrical rhythm patterns — they reported statistically significant reductions in pain based on the VAS (visual analogue scale) after 24 hours and 3 days (8). Patients who underwent chemotherapy and subsequent stem cell transplantation required fewer doses of narcotic pain medication equivalent to morphine (9). Likewise, music therapy reduced the VAS pain score of cancer patients on morphine in comparison to patients on morphine who did not receive music therapy (10). In patients with chronic pain (lasting longer than 3 months), music therapy significantly alleviated that pain as well as depression (11). Furthermore, in patients visiting the emergency department due to pain, music therapy reduced pain significantly as compared to patients who did not receive music therapy, especially for non-trauma-related pain — which would apply to autoimmune disease (12). Such differences in pain, anxiety, and depth of sedation when music therapy is administered signify a genuine potential of music to encourage tranquility and reduce discomfort while a patient is experiencing disease symptoms or pain.

Regarding the studies reviewed, sample sizes vary from 9 (2) to 931 (8) participants. All studies include solely human participants except for one, which includes guinea pigs as well to explore somatosensory pathways (2). Methodologies are diverse across the studies. The majority of studies discussing music therapy's effects on pain or anxiety use the VAS or A-VAS scales, which are based on patient ratings of their experiences (not exactly quantitative data measured by researchers); however, those discussing neural pathways and autoimmune disease therapies include more clearly measured, quantitative, and research-based data. The highest quality studies are likely the randomized controlled trials (4, 7, 9, 12) thanks to their minimal bias and more effective elimination of outside variables.

The primary limitation across all studies reviewed is that they do not explicitly address music's specific role in autoimmune disease pain. It appears that this particular outlet for music therapy has not yet been investigated through formal research studies, which suggests an existing gap that could be filled with valuable data going forward. However, music therapy's roles in stress reduction, anxiety relief, and mood improvement, and music's connections to pain with respect to their perception by the brain, indicate a significant likelihood of its usefulness for autoimmune disease patients who suffer from incurable pain.

METHODS AND MATERIALS

This literature search was conducted using PubMed, Cochrane Library, and Google Scholar. These databases offered an extensive collection of studies and meta-analyses that provided insight into music therapy's various uses, autoimmune disease functioning, and the coinciding areas of pain perception and auditory processing. Keywords included auditory stimuli, autoimmune disease treatment, music intervention, music therapy, and pain perception. Search strings

used were "music therapy AND autoimmune disease," "music therapy AND pain perception," "auditory stimuli OR auditory perception," and "music therapy -neurodegenerative." MeSH terms searched were "Music Therapy," "Autoimmune Diseases," "Pain Perception," "Auditory Perception," and "Receptors, Dopamine." A total of 20 studies out of 38 retrieved met the inclusion criteria (published between 01 May 2013 and 01 August 2025, conducted in the Americas or Asia) while the other 18 met at least one of the exclusion criteria (not in English, participants under 18 or over 80 years of age). Duplicate studies were removed. Search filters were also then applied to expedite the process of verifying inclusion and exclusion criteria: publication date (within the last 12 years), language (English), and continent (Americas and Asia). Finally, the "+1, 0, –1" scoring system (Table 2) classifies each study by its support of the hypothesis that music therapy may effectively mitigate autoimmune pain. +1 means the study supports music's alleviation of pain; 0 means the study indicates that music's effect on pain is negligible, or does not discuss this effect; –1 means the study indicates pain exacerbation by music.

Table 2. *Summary of primary studies included in this review, including study design, population characteristics, intervention type, outcome measures, and key findings related to music intervention and pain modulation.*

TITLE	REFERENCE NUMBER	SUMMARY	SUPPORT OF HYPOTHESIS
Music therapy interventions in Parkinson's disease: the state-of-the-art	1	This narrative review explores the state-of-the-art applications of Neurologic Music Therapy specifically within the context of Parkinson's Disease. The author examines how Rhythmic Auditory Stimulation functions as a primary intervention to improve motor symptoms and non-motor distress. By utilizing rhythmic cues to enhance auditory-motor coupling, the study highlights how music can promote neuroplasticity. In the autoimmune context, this research is vital as it demonstrates the "entrainment effect," a mechanism by which music can stabilize the central nervous system's response to the chronic, often unpredictable neural "noise" and discomfort associated with these inflammatory conditions.	0
Topographic and widespread auditory modulation of the somatosensory cortex: potential for bimodal sound and body stimulation for pain treatment	2	In this fMRI-based experimental study, researchers investigated how music influences the brain, brainstem, and spinal cord during the processing of thermal pain stimuli in healthy volunteers. The methodology involved comparing the effects of favorite, highly pleasurable music against neutral sounds or silence. The findings revealed that pleasurable music activates the Descending Pain Modulatory System, particularly the periaqueductal gray, which in turn suppresses nociceptive signaling in the dorsal horn of the spinal cord. This provides a clear neurological blueprint for how music can physically block the bottom-up pain signals frequently reported in autoimmune neuropathies.	+1
Pain and the immune system: emerging concepts of IgG-mediated autoimmune pain and immunotherapies	3	This clinical review and case series focused on the biological underpinnings of small fiber neuropathy in patients with autoimmune markers. Using nerve conduction studies, skin biopsies, and autoantibody testing, the researchers identified that allergic inflammation and specific autoantibodies (IgG) targeting dorsal root ganglion neurons are primary drivers of chronic neuropathic pain. The study establishes the biological target for music therapy, suggesting that music's ability to modulate central sensitization is crucial for patients whose peripheral nerves are under constant autoimmune attack.	0

Continued Table 2. *Summary of primary studies included in this review, including study design, population characteristics, intervention type, outcome measures, and key findings related to music intervention and pain modulation.*

TITLE	REFERENCE NUMBER	SUMMARY	SUPPORT OF HYPOTHESIS
The effect of music therapy on cognitive functions in patients with Alzheimer's disease: a systematic review of randomized controlled trials	4	This systematic review of randomized controlled trials assessed the efficacy of both receptive and active music therapy in patients with Alzheimer's Disease and cognitive impairment. Using outcome measures like the Mini-Mental State Examination and the Neuropsychiatric Inventory, the study found that music significantly reduces anxiety and enhances cognitive engagement via dopaminergic pathways. For autoimmune pain, this research is relevant because it supports the use of music to treat cognitive "fog" and emotional distress that often exacerbate the perceived intensity of physical pain.	0
Why musical memory can be preserved in advanced Alzheimer's disease	5	Through a neuroimaging meta-analysis, the authors propose that music serves as a "predictive scaffolding" for the human brain. By engaging large-scale networks, including the prefrontal, limbic, and motor regions, music creates a high-level cognitive demand that competes with pain signals for limited attentional resources. This theory is particularly applicable to autoimmune conditions, as it suggests that familiar music can reduce the cognitive load and uncertainty associated with unpredictable flare-ups, effectively distracting the brain from chronic pain signals.	0
Comparing the effects of different individualized music interventions for elderly individuals with severe dementia	6	This observational clinical review evaluates the "Music Care" method, a receptive music intervention characterized by the "U" sequence (a gradual decrease in tempo and frequency to induce deep relaxation). Tested on patients with chronic pain, including those with Rheumatoid Arthritis and Fibromyalgia, the study measured outcomes using the Visual Analogue Scale (VAS). The results showed significant reductions in pain scores and a decreased reliance on pharmacological interventions like opioids. This provides clinical evidence for music as a viable tool in the long-term management of autoimmune-linked chronic pain.	+1
Effect of Preoperative Music Therapy Versus Intravenous Midazolam on Anxiety, Sedation and Stress in Stomatology Surgery: A Randomized Controlled Study	7	This RCT utilized mixed methods to study the impact of a 12-week Vocal Music Therapy program on Black and minority patients suffering from chronic pain. Utilizing PROMIS scales to measure pain interference and anxiety, the researchers found that active participation in singing improved pain self-efficacy and social participation. Qualitative data suggested that the spiritual and communal connection fostered by Vocal Music Therapy served as a psychological buffer. This highlights the importance of active, culturally relevant music-making in improving the quality of life for those with systemic autoimmune diseases.	+1
Non-pharmacological interventions for alleviating pain during orthodontic treatment	8	In a comprehensive Systematic Review, the authors analyzed the effects of music therapy versus standard care in patients with cancer and related chronic pain. The review found high-level evidence that music therapy reduces pain intensity (measured by VAS) and improves physiological markers like heart and respiratory rates. This meta-analysis establishes the solid evidence base for music as a non-pharmacological pain reliever, which can be extrapolated to the complex pain profiles found in various autoimmune disorders.	+1

Continued Table 2. *Summary of primary studies included in this review, including study design, population characteristics, intervention type, outcome measures, and key findings related to music intervention and pain modulation.*

TITLE	REFERENCE NUMBER	SUMMARY	SUPPORT OF HYPOTHESIS
Music Therapy for Symptom Management After Autologous Stem Cell Transplantation: Results From a Randomized Study	9	This longitudinal observational study examined patients undergoing hematopoietic cell transplants for both malignant and autoimmune conditions. The researchers focused on the temporal dynamics of T-cell receptors and their link to patients' reported distress and pain. The findings suggest a strong correlation between the neuroimmune axis and subjective pain. This provides a theoretical framework for how music therapy might influence the immune system by dampening the stress-induced inflammatory responses that drive autoimmune pain.	+1
Effect of Music Therapy on Pain and Anxiety Levels of Cancer Patients: A Pilot Study	10	This experimental cross-sectional study investigated the effects of favorite music on pain thresholds using a Pain Vision System (electrical stimulation). The study found that listening to self-selected favorite music increased the pain threshold by over 25% and significantly modulated activity in the Anterior Cingulate Cortex. This research is relevant to autoimmune pain management; it emphasizes that listening to music one enjoys is key to raising the biological threshold for inflammatory pain perception.	+1
The effect of music therapy for patients with chronic pain: systematic review and meta-analysis	11	In the primary pre-test / post-test study analyzed by this Systematic Review, researchers provided 30 minutes of recorded music with a slow tempo to 47 hospitalized patients. Using the Numeric Rating Scale, the study recorded a statistically significant reduction in pain levels post-intervention. These findings demonstrate the practical, low-cost utility of music therapy in acute care settings, making it an ideal supplemental treatment for autoimmune patients experiencing intense pain during hospital stays or flare-ups.	+1
The effect of music therapy on treating patients' pain and anxiety in emergency department: a randomized controlled trial	12	This Randomized Controlled Trial conducted in an Emergency Department examined the efficacy of a 30–40 minute session with a certified music therapist. Patients receiving music therapy alongside standard pain medication reported a pain reduction of 1.52 points (on a 0–10 scale), compared to only 0.09 in the control group. The study specifically noted that music was most effective for non-trauma pain, which suggests that music therapy is a potent tool for addressing the emotional and sensory distress of chronic autoimmune pain.	+1
Resource Allocation in the Brain	13	This review from the perspective of behavioral economics discusses decision fatigue and "cognitive scarcity" caused by chronic health conditions. Applied to music, this suggests that music therapy can act as an aid that restores cognitive space to the patient. By reducing the mental tax of chronic autoimmune pain, music helps patients better manage their other treatments and daily functioning.	+1
Music as a coevolved system for social bonding	14	This Narrative Review explores the evolutionary origins of music as a social bonding mechanism. The authors highlight that collective musical activities trigger the release of endorphins, which naturally alleviate pain and foster social cohesion. This perspective is vital to autoimmunity, as it suggests that the social and collective aspects of music are effective in stimulating dopaminergic activity and treating the physical pain caused by autoimmune disease.	+1

Continued Table 2. *Summary of primary studies included in this review, including study design, population characteristics, intervention type, outcome measures, and key findings related to music intervention and pain modulation.*

TITLE	REFERENCE NUMBER	SUMMARY	SUPPORT OF HYPOTHESIS
B cell depletion therapies in autoimmune disease: advances and mechanistic insights	15	This drug discovery review details the latest advancements in B-cell therapies for neuroinflammatory autoimmune diseases like Multiple Sclerosis and Systemic Lupus Erythematosus. By identifying the drivers (specifically faulty B-cells) of chronic pain states, this study provides the biological context behind autoimmune pain perception. It foundationally explains what music therapy aims to control: the hypersensitized neural pathways created by a malfunctioning immune system.	0

+1 indicates pain mitigation; 0 indicates no effect on pain; –1 indicates pain exacerbation.

RESULTS AND DISCUSSION

Music therapy has numerous uses, whether in neurodegenerative disease, cognitive function restoration, motor function restoration, anxiety management, pre-operative sedation, or pain mitigation. Although music has not specifically been studied in relation to autoimmune disease, there is sufficient evidence to posit that it is an effective tool for alleviating discomfort due to inflammatory symptoms — likely equally as effective as it is for its other known and tested uses. The coinciding of pain perception, auditory and other sensory stimuli, and autoimmune attacks in the somatosensory cortex of the brain is significant support for music therapy's efficacy. It is absolutely reasonable that the sensory stimulus of music should affect the perception of pain when processed through the somatosensory pathways, particularly as IgG antibodies attack antigens in similar locations of this cortex. Additional research and review is necessary to investigate further the direct impacts of music therapy on patients with pain caused by autoimmune disorders.

The resource allocation theory (the brain's focusing on more relevant stimuli at a given moment) further exemplifies the ability of music to alleviate painful sensations (13). When pain is being perceived in the parietal lobe of the brain, specifically the somatosensory cortex, and music therapy is administered, the pain can no longer be entirely processed through the thalamus and somatosensory pathways. Such complex auditory stimuli require thorough processing by the neurons in these regions of the brain, so the music takes precedence over the sensations of pain, distracting the brain from the severity of the pain (Figure 1). According to the

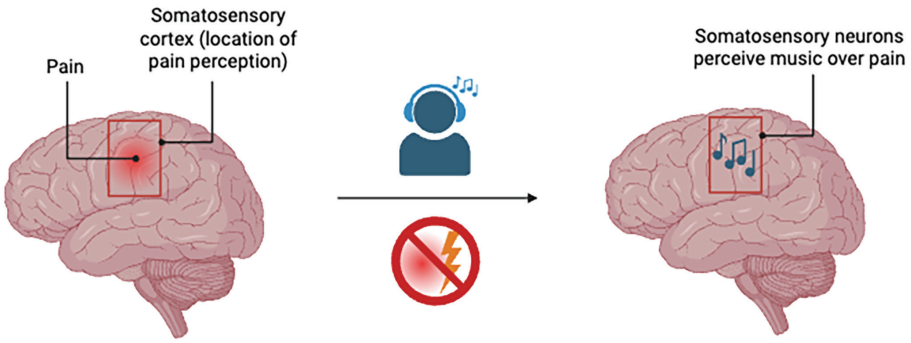

Figure 1. *Resource allocation theory. When pain is being perceived in the parietal lobe of the brain — specifically the somatosensory cortex — and music therapy is administered, the pain can no longer be entirely processed through the thalamus and somatosensory pathways. Such complex auditory stimuli require thorough processing by the neurons in these regions of the brain, so the music takes precedence over the sensations of pain, distracting the brain from the severity of the pain. According to the theory, the brain must, after all, focus its limited energy and perception capacity on the most apparent topic or stimulus.*

theory, the brain must, after all, focus its limited energy and perception capacity on the most apparent topic or stimulus.

Furthermore, the hormonal pain reduction theory, the ability of chemical signals to lead to pain reduction when bound to their receptors, serves as expanded evidence of this neurological concept. When music therapy is administered, the pleasurable sensory stimulus leads to increased dopaminergic activity throughout the brain. This, in turn, stimulates feelings of pleasure and increases neuronal excitability, which distracts the somatosensory pathways from the pain processing signals (Figure 2). This process relates to the resource allocation theory in that the brain focuses on the most apparent stimulus at any given time, so once music stimulates the release of dopamine, causing the hormone to bind to its receptors, the perception of pain is remarkably less intense.

A final possible contributor to music's ability to alleviate pain is the social bonding that music fosters. Anthropologists and psychologists have converged on the likelihood that music and dance together have evolved in both internally biological and externally cultural manners to serve as methods of strengthening relationships within communities (14). Moreover, the rhythmic physical behaviors stimulated by music often contribute to altered states of consciousness across these community members, allowing trust to be established among them. Such an effect on the brain's perception likely affects pain perception as well; in fact, it is known that social interaction and building relationships leads to an increase in dopaminergic activity, which, as displayed by the hormonal pain reduction theory, reduces pain perception through increased levels of pleasure and neuronal excitability.

All three of these theories appear closely interconnected and significantly plausible as they are supported by accepted neurological data and trends. It is possible for one to argue that music does not release adequate dopamine to effectively relax and distract patients from autoimmune pain; however, this claim is refuted by the numerous studies citing music as a therapy equally effective as midazolam in sedating patients and reducing anxiety, known for promoting social bonding and strong feelings of pleasure through hormonal activity. There is sufficient evidence to support that music therapy influences pain perception in a way that can reduce pain; more investigations may be conducted to examine the direct effects of music therapy on autoimmune disease symptoms.

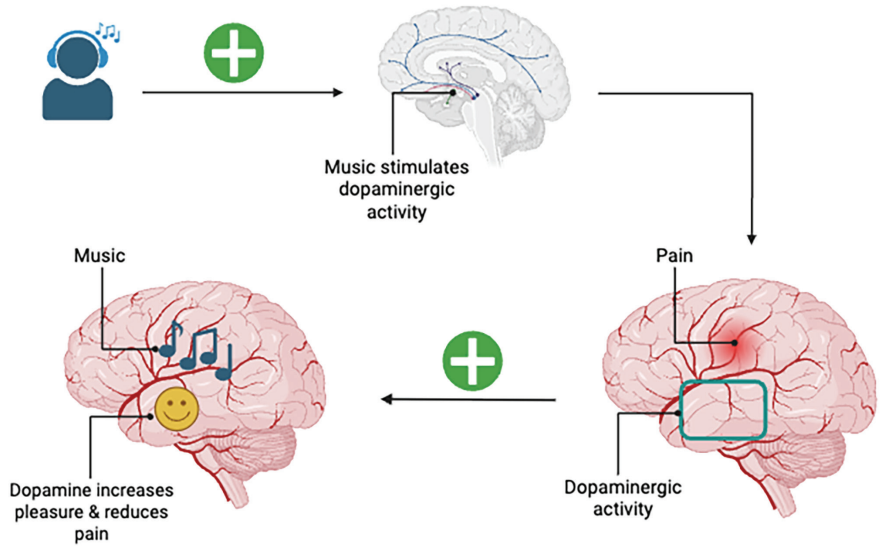

Figure 2. *Hormonal pain reduction theory. When music therapy is administered, the pleasurable sensory stimulus leads to increased dopaminergic activity throughout the brain (pathways pictured above). This, in turn, stimulates feelings of pleasure and increases neuronal excitability, which distracts the somatosensory pathways from the pain processing signals. This relates to the resource allocation theory in that the brain focuses on the most apparent stimulus at any given time, so once music stimulates the release of dopamine, causing the hormone to bind to its receptors, the perception of pain is remarkably less intense.*

CONCLUSION

As a sensory, non-pharmacological intervention, music therapy is certainly a feasible option for autoimmune patients' care. Over the last two decades, therapies involving targeted B cell depletion have been explored since these cells are critical to the faulty immune response that drives autoimmunity (15). Since these therapies in practice have often displayed side effects leading to a higher frequency of illness and feeling unwell, music therapy would be ideal to incorporate into this treatment plan — once the side effects are felt, music would allow patients to take their mind off of their discomfort thanks to the resource allocation and hormonal pain reduction theories. Moreover, no ethical complications arise with the implementation of music therapy, making it a simple, effective, and practical option for patients with autoimmune disease.

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CONFLICT OF INTEREST

The author declares that there are no conflicts of interest related to this work.

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