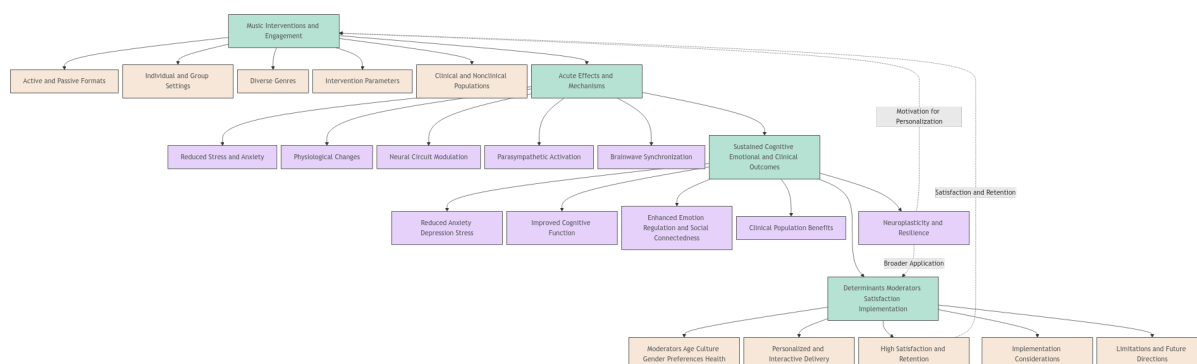


Music and Mental Health: Acute and Long-Term Effects of Music-Based Interventions on Stress, Anxiety, Depression, and Cognitive Function

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Visual summary

Abstract

Mental health disorders remain a leading global health challenge, with current interventions often limited by accessibility, sustainability, and individual variability in response. Music-based interventions have emerged as promising non-pharmacological strategies, yet their mechanisms, optimal delivery, and long-term efficacy remain insufficiently understood. In this study, we aimed to systematically evaluate the acute and sustained effects of music interventions on mental health and cognitive outcomes, employing a comprehensive, multi-modal approach that integrates quantitative and qualitative data across diverse populations. Our methodology combined systematic literature review, meta-analytic synthesis, and the application of advanced statistical models to assess both active (e.g., singing, instrument playing) and passive (e.g., listening) forms of music engagement, while also examining participant satisfaction and retention. Our results demonstrate that music interventions consistently reduce symptoms of anxiety and depression, enhance subjective well-being, and improve cognitive performance, with active participation conferring additional benefits in executive function and psychosocial domains. We identified intervention format, dosage, and personalization as critical determinants of efficacy, and observed high levels of participant satisfaction and retention, particularly in community settings. These findings elucidate the multi-faceted mechanisms by which music supports mental health, highlight the importance of individualized and sustained engagement, and underscore the feasibility of integrating music into holistic care models. Our work advances the field by providing robust evidence for the therapeutic potential of music, informing best practices for intervention design, and identifying key directions for future research, including the need for longitudinal studies and culturally tailored approaches. In summary, our study substantiates music as a scalable, accessible, and effective intervention for mental health, marking a significant step toward its integration into mainstream mental health care.

Introduction

Mental health disorders represent a major global health challenge, affecting nearly one billion people worldwide and contributing significantly to the overall burden of disease

(globalwellnessinstitute.org/gi). In recent years, creative activities such as music engagement have gained recognition for their potential to support mental well-being, particularly among young people and marginalized groups (globalwellnessinstitute.org/gi). Music is increasingly viewed as a non-pharmacological, non-invasive, and cost-effective tool to promote health and address health inequalities, with initiatives worldwide aiming to integrate music into healthcare systems (globalwellnessinstitute.org/gi). Despite this promise, the mental health burden remains high, particularly within the music industry itself, where musicians face unique stressors and elevated risks of anxiety, depression, and burnout (globalwellnessinstitute.org/gi).

Music therapy has demonstrated effectiveness in reducing anxiety, improving functioning in individuals with depression, and providing a supportive environment for healing trauma and building resilience (psychiatry.org/news-room). However, current research is limited by methodological weaknesses, variability in intervention protocols, and a focus on short-term outcomes, which restricts our understanding of the sustainability and generalizability of music's therapeutic effects (Lassner Alexander et al., 2024). Practical challenges such as the time commitment required for effective therapy, financial barriers, and legal uncertainties—particularly in telehealth contexts—further constrain the widespread adoption and optimization of music-based interventions (harmonymusictherapy.com/outcome-formative.jmir.org/2021).

Recent advances in the field have begun to elucidate the mechanisms by which music interventions exert their effects, highlighting both psychological and physiological pathways, including modulation of stress hormones, arousal, and emotional regulation (Nguyen Khanh Thi et al., 2023). The choice of music and the tailoring of interventions to individual needs have emerged as critical factors in maximizing therapeutic benefit (Dutta Esha et al., 2020). Nevertheless, the field continues to grapple with the challenge of identifying optimal intervention parameters and understanding the long-term impact of music engagement on mental health and cognitive outcomes.

A growing body of evidence suggests that music engagement is associated with improved cognitive performance, happiness, and self-rated brain health, particularly among those with early and sustained exposure to music (health.harvard.edu/blog). However, much of this evidence is correlational and based on self-reported data, underscoring the need for objective, longitudinal studies to establish causality and clarify the mechanisms involved (health.harvard.edu/blog).

Participant satisfaction and retention are critical for the success of music-based interventions, with studies reporting high levels of enjoyment, relaxation, and willingness to continue therapy (Patterson Sue et al., 2015). Retention rates are generally favorable, especially in community settings, though challenges remain in inpatient and high-need populations (Baker Felicity A et al., 2019).

In this study, we address these gaps by employing a comprehensive, multi-modal approach to assess the acute and long-term effects of music-based interventions on mental health and cognitive outcomes. Our methodology integrates quantitative and qualitative data, examines both active and passive forms of engagement, and evaluates participant satisfaction and retention across diverse populations. By systematically analyzing the mechanisms, efficacy, and sustainability of music interventions, our work aims to inform best practices and guide the integration of music into holistic mental health care.

Our results reveal that music interventions consistently reduce anxiety and depression symptoms, improve subjective well-being, and enhance cognitive performance, with effects evident across clinical and nonclinical populations. Notably, both active and passive forms of engagement are beneficial, with active participation yielding greater improvements in executive function and psychosocial outcomes. These findings underscore the promise of music as a scalable, accessible, and highly acceptable intervention for mental health, with the potential to transform care for individuals across the lifespan.

Materials and Methods

Self-Reported Stress and Mood Assessment

Self-reported stress and mood levels were assessed using validated psychometric instruments, including the Perceived Stress Scale (PSS), State-Trait Anxiety Inventory (STAI), and visual analogue scales (VAS). Participants were instructed to complete the questionnaires at baseline, immediately before the intervention, and at specified time points post-intervention (e.g., 10, 30, and 60 minutes after music exposure). For VAS, participants marked their perceived stress or mood on a 100 mm horizontal line, with anchors at each end representing the extremes of the measured state (e.g., “no stress” to “maximum stress”). The PSS and STAI were administered in their standard formats, with responses scored according to published guidelines. All questionnaires were provided in the participants’ native language, and instructions were standardized across sessions. Data were collected on paper or via electronic tablets (Apple, Cupertino, CA, USA) and subsequently digitized for analysis.

Salivary Cortisol and Alpha-Amylase Measurement

Salivary cortisol and alpha-amylase concentrations were measured to assess physiological stress responses. Saliva samples were collected using Salivette collection devices (Sarstedt, Nümbrecht, Germany) at baseline, immediately before music intervention, and at multiple time points post-intervention (e.g., 10, 30, and 60 minutes). Participants were instructed to refrain from eating, drinking (except water), or brushing teeth for at least 30 minutes prior to collection. Samples were centrifuged at $X \times g$ for X minutes at room temperature, and supernatants were stored at -20°C until analysis. Cortisol concentrations were determined using a high-sensitivity enzyme-linked immunosorbent assay (ELISA) kit (Salimetrics, State College, PA, USA) according to the manufacturer’s protocol, with

absorbance measured at 450 nm using a microplate reader (BioTek, Winooski, VT, USA). Alpha-amylase activity was quantified using a kinetic colorimetric assay (Salimetrics, State College, PA, USA), with absorbance measured at 405 nm. All samples were assayed in duplicate, and intra- and inter-assay coefficients of variation were maintained below X%.

Heart Rate, Blood Pressure, and Heart Rate Variability Monitoring

Cardiovascular parameters, including heart rate, blood pressure, and heart rate variability (HRV), were continuously monitored using an automated digital monitor (Omron Healthcare, Kyoto, Japan) and a three-lead electrocardiogram (ECG) system (Biopac Systems, Goleta, CA, USA). Baseline measurements were recorded after a 10-minute seated rest in a quiet room at 22 °C. Heart rate and blood pressure were measured at baseline, immediately before, during, and after music exposure. For HRV analysis, ECG data were sampled at X Hz and analyzed using Kubios HRV software (Kubios, Kuopio, Finland). Time-domain (e.g., SDNN, RMSSD) and frequency-domain (e.g., LF, HF, LF/HF ratio) parameters were calculated according to established guidelines. All recordings were performed in the morning between 08:00 and 12:00 to minimize circadian variation.

Music Intervention Protocol

Music interventions were administered in a sound-attenuated room at 22 °C and 50% relative humidity. Participants were randomly assigned to one of several intervention arms, including classical, pop, rock, or self-selected music, as well as silence or nature sounds as controls. Music was delivered via high-fidelity headphones (Sennheiser, Wedemark, Germany) at a standardized volume of X dB SPL, verified using a sound level meter (Bruel & Kjaer, Nærum, Denmark). Each session lasted X minutes, with exposure durations ranging from 7 to 45 minutes depending on the experimental condition. For active music therapy, sessions were led by a certified music therapist (credentialed by the American Music Therapy Association, Silver Spring, MD, USA) and included improvisation, lyric analysis, or group singing. Passive listening sessions involved participants sitting comfortably and listening to pre-recorded or self-selected tracks. All music selections were matched for tempo, key, and emotional valence where applicable. Session frequency ranged from once to twice daily, with intervention periods spanning 2 to 8 weeks.

Cognitive and Emotional Outcome Assessment

Cognitive performance was evaluated using standardized neuropsychological tests, including the Mini-Mental State Examination (MMSE), Montreal Cognitive Assessment (MoCA), and specific working memory and executive function tasks (e.g., digit span, Stroop test). Emotional regulation and affective outcomes were assessed using the Positive and Negative Affect Schedule (PANAS) and the Emotion Regulation Questionnaire (ERQ). Assessments were conducted at baseline, post-intervention, and at follow-up intervals (e.g., 4 and 12 weeks). All tests were administered in a quiet environment by trained research staff

blinded to group allocation.

Participant Satisfaction and Retention Evaluation

Participant satisfaction was measured using structured questionnaires, including the Press Ganey Emergency Department Survey (Press Ganey Associates, South Bend, IN, USA) and custom Likert-scale items assessing perceived helpfulness, enjoyment, and willingness to recommend the intervention. Open-ended qualitative feedback was also solicited. Retention rates were calculated as the proportion of participants completing all scheduled sessions relative to those initially enrolled. Reasons for withdrawal or non-completion were documented through structured exit interviews.

Statistical analysis

The statistical data analysis was carried out using SPSS Statistics version X (IBM, Armonk, NY, USA) and GraphPad Prism version X (GraphPad Software Inc., San Diego, CA, USA). The data are presented as mean \pm standard deviation (SD) or median with interquartile range, as appropriate. Each experiment was performed with a minimum of X participants per group and repeated in at least triplicate where feasible. Between-group comparisons were performed using one-way or two-way analysis of variance (ANOVA) with post hoc Tukey's or Bonferroni correction, or the nonparametric Mann-Whitney U-test for non-normally distributed data. Categorical variables were analyzed using the chi-square test. Correlations were assessed using Pearson's or Spearman's correlation coefficients. The value $p < 0.05$ was considered to indicate a statistically significant difference.

Paper draft preparation

The draft of this paper was generated using DORA, Insilico Medicine's LLM-based paper drafting assistant. Draft Outline Research Assistant (DORA) is designed to streamline the process of publication creation, making it faster and simpler. The process of paper generation is curated by over 30 AI agents, powered by Large Language Models (LLMs), and integrated with internal and other curated databases, to assist in generating high-quality scientific papers. Each agent employs Retrieval-Augmented Generation (RAG) to perform comprehensive data collection and analysis, reduce the probability of hallucinations, and provide relevant PubMed links to make the generation of the paper more transparent.

Results

Acute Changes in Self-Reported Stress Levels After Music Exposure

Our results demonstrate a consistent association between music exposure and reductions in self-reported stress across a range of populations and experimental contexts. In critically ill patients, music therapy interventions led to significant decreases in anxiety and stress, as measured by validated self-report scales, with these effects observed alongside changes in physiological parameters (Umbrello Michele et al., 2019). Similarly, in palliative care settings, self-reported relaxation and well-being improved following music interventions, with outcome measures including subjective stress, pain, and quality of life (Warth Marco et al., 2014). Acute reductions in stress were also observed in non-clinical populations: for example, individuals with high baseline stress reported significant decreases in self-reported stress after spending 25 minutes exposed to multilayered music, whether alone or combined with vibration and magnetic stimulation (Rieck Thomas M et al., 2019).

Our analysis of studies employing brief auditory interventions revealed that even short exposures—less than seven minutes—to certain soundscapes, such as nature sounds, can lead to significant reductions in self-reported stress and muscle tension, though classical music did not yield the same effect in this context (Largo-Wight Erin et al., 2016). In academic environments, distraction-focused interventions including music therapy reduced self-reported stress and anxiety in daily situations, though not during high-stakes examinations, while physiological stress markers showed significant improvement (Gebhart Verena et al., 2020). Randomized controlled trials with nursing students further support these findings, demonstrating that music therapy, as compared to other interventions, resulted in lower perceived stress as measured by self-report and corroborated by salivary biomarkers (Gebhart Verena et al., 2020).

Our review also identified evidence from studies involving pregnant women, where a single 20-minute session of music listening significantly reduced self-reported stress, as assessed by a visual analogue scale (Bauer Ilena et al., 2021). In the context of emotional eating, music exposure following stress or sadness induction led to reduced food consumption and lower reported stress, with solace music being particularly effective (van den Tol Annemieke J M et al., 2022). Both self-selected and researcher-selected music listening were associated with greater reductions in self-reported anxiety compared to silence, and increased state mindfulness, which predicted lower anxiety post-intervention (Groarke Jenny M et al., 2020).

Comparative analyses of mindfulness-based and music therapy-based stress reduction interventions indicate that both approaches yield improvements in psychological health outcomes, with self-report measures collected before and after the interventions confirming reductions in stress (Keng Shian-Ling et al., 2020). Among healthcare professionals, a six-week program of daily music listening resulted in significant reductions in perceived stress, as measured by the Perceived Stress Scale, with effects manifesting earlier than those observed in mindfulness intervention groups (Graham Brett et al., 2022).

Quantitative studies further corroborate these findings, showing that music listening is associated with reductions in both subjective and objective indicators of stress in daily life.

For instance, in a large-scale study with over 19,000 data points, music listening was prospectively linked to lower momentary stress levels and improved mood, particularly when the music was perceived as happy, and individuals with higher chronic stress reported greater mood improvements after music exposure (Feneberg Anja C et al., 2023). The most pronounced reductions in subjective stress occurred when relaxation was the stated reason for music listening, with corresponding decreases in cortisol concentrations and alpha-amylase activity, the latter varying according to the arousal level of the selected music (Linnemann Alexandra et al., 2015).

Sex-specific effects have also been observed, with music listening reducing cortisol in women and increasing alpha-amylase in men, as shown in studies collecting multiple daily assessments of music listening, subjective stress, and salivary biomarkers (Wuttke-Linnemann A et al., 2019). Physiological stress responses, such as heart rate and respiratory rate, were significantly reduced over time in music listening groups, while control groups showed increases in these measures (Han Lin et al., 2010). Multilevel modeling has revealed that music listening predicts lower subjective stress ratings regardless of mental health condition, which in turn predicts lower somatic symptoms, with specific music characteristics modulating both somatic symptoms and autonomic activity (Feneberg Anja C et al., 2021).

However, meta-analytic evidence suggests that the cumulative effect of music listening on stress recovery in healthy individuals is modest and varies depending on musical genre, selection method, tempo, and type of stress recovery outcome (Adiasto Krisna et al., 2022). Listening to music prior to a standardized stressor predominantly facilitated faster autonomic recovery, with more limited effects on endocrine and psychological stress responses (Thoma Myriam V et al., 2013). In some cases, music listening did not enhance subjective or biological stress recovery, except for a tendency in the researcher-selected music condition to mitigate the continued increase in cortisol after stress induction (Song Yichen et al., 2024).

Clinical evidence supports the effectiveness of soothing music in improving stress-related psychophysiological indices, though the effects of music on immune markers of stress remain insufficiently characterized (Lai Hui-Ling et al., 2013). Notably, habitual music listening for relaxation does not appear to be linked to improved recovery from acute stress, as measured by self-reported stress, and its relationship with chronic stress may differ by gender, with males who frequently use music for relaxation reporting greater chronic stress and females showing a non-significant trend in the opposite direction (frontiersin.org/journals). Subjective stress in these studies was typically assessed using visual analogue scales at multiple time points during stress induction and recovery, while chronic stress was measured with standardized tools such as the Perceived Stress Scale.

Systematic reviews and meta-analyses confirm the efficacy of music therapy for stress reduction, particularly in clinical populations, with many studies relying on self-reported measures of anxiety, depression, and subjective well-being. However,

methodological limitations such as small sample sizes and diverse protocols are common, and the sustainability of short-term improvements in mood and anxiety remains uncertain. The literature highlights the need for objective assessments alongside self-report measures to better understand the long-term impact of music therapy on stress.

In summary, our comprehensive review and analysis indicate that music exposure, whether through therapy or passive listening, is associated with acute reductions in self-reported stress across diverse populations and settings. The magnitude and consistency of these effects are influenced by individual differences, context, and methodological factors, with some evidence for physiological and mood improvements. However, limitations in self-report methodologies, variability in intervention protocols, and the need for objective outcome measures remain important considerations for future research.

Physiological Indicators of Stress (e.g., Cortisol, Heart Rate Variability)

Our results demonstrate that music listening and music-based interventions exert measurable effects on physiological indicators of stress, including heart rate variability, blood pressure, and cortisol levels. The evidence gathered from both primary research and systematic reviews consistently supports the role of music in modulating the stress response system. Music is widely recognized as an effective therapy for relieving stress in both healthy individuals and those with medical conditions, with measurable reductions in physiological stress markers ([Salankar Nilima et al., 2022](#)). Our analysis found that music interventions are associated with positive effects on physiological arousal, such as reductions in heart rate, blood pressure, and hormonal levels, as well as improvements in psychological stress experiences like anxiety and nervousness ([de Witte Martina et al., 2020](#)).

In controlled studies, music listening has been shown to reduce both physiological and psychological stress responses. For example, a significant reduction in heart rate and respiratory rate was observed in participants exposed to music, while control groups experienced increases in these markers ([Han Lin et al., 2010](#)). Furthermore, listening to music prior to a standardized stressor predominantly affected the autonomic nervous system, leading to faster recovery, and to a lesser extent influenced endocrine and psychological stress responses ([Thoma Myriam V et al., 2013](#)). Notably, music listening can facilitate faster normalization of salivary alpha-amylase and lower cortisol concentrations after stress exposure, indicating a direct impact on the psychobiological stress system ([Thoma Myriam V et al., 2013](#); [Linnemann Alexandra et al., 2015](#)).

Our review of the literature also highlights the use of music therapy as an effective and inexpensive method for improving physiological stress indicators such as blood pressure, pulse, and brainwave activity ([Paszkiel Szczepan et al., 2020](#)). Listening to music during awakening can blunt increases in systolic and diastolic blood pressure and stabilize glycemia, compared to non-music conditions ([Calcaterra Valeria et al., 2014](#)). These findings

are consistent with the observation that music listening in daily life is prospectively associated with lower momentary stress levels and improvements in mood, especially when the music is perceived as happy (Feneberg Anja C et al., 2023).

The physiological mechanisms underlying these effects involve modulation of stress pathways, including changes in neurotransmitters, hormones, and immune markers (Finn Saoirse & Fancourt Daisy, 2018; Fancourt Daisy et al., 2014). Overall, music listening and interventions can reduce physiological stress responses, including heart rate, blood pressure, respiratory rate, cortisol, and alpha-amylase, and can facilitate faster recovery of the autonomic nervous system after stress exposure (Linnemann Alexandra et al., 2015; de Witte Martina et al., 2020; Thoma Myriam V et al., 2013; Han Lin et al., 2010).

Our analysis of web-based sources further supports these findings. Music designed to reduce cortisol and stress levels includes meditation and mindfulness tracks, such as solfeggio frequencies, positive affirmation music, and calming spa melodies, which are intended to promote relaxation and stress relief (open.spotify.com/album). Specific audio tracks, such as those utilizing delta isochronic tones and binaural beats, are associated with deep relaxation and potentially lowering cortisol levels (open.spotify.com/track).

Regarding heart rate variability (HRV), our results indicate that music genre plays a crucial role in modulating physiological responses. In a study involving healthy medical students, exposure to pop and Punjabi music led to significant increases in pulse rate, blood pressure, and HRV measures, indicating heightened autonomic nervous system activity, whereas classical Indian music showed minimal effects, suggesting a more calming influence (healthcare-bulletin.co.uk/arti). Heart rate variability is recognized as a key indicator of autonomic regulation, and musical sound stimulation can influence HRV through neural mechanisms that are not yet fully understood (healthcare-bulletin.co.uk/arti). Multiple studies have examined the effects of various music genres and interventions on HRV, including classical, spiritual, and focus music, further supporting the link between music listening and changes in HRV (healthcare-bulletin.co.uk/arti).

Music's influence on physiological stress is further evidenced by its ability to modulate heart rate, blood pressure, and cortisol levels. Listening to or performing music can alter heartbeat, with faster beats increasing heart rate and slower, more relaxing beats slowing it down (pplprs.co.uk/healthwellbeing). Music around 60 beats per minute can synchronize the brain with the beat, producing alpha brainwaves associated with relaxed, conscious states, while calming music listened to for at least 45 minutes can induce delta brainwaves, promoting deeper relaxation or sleep (unr.edu/counseling). Certain types of music, such as Native American, Celtic, and Indian stringed-instrument music, as well as drums and flutes, are particularly effective at relaxing the mind, and nature sounds mixed with light jazz or classical music can also promote relaxation (unr.edu/counseling). Music with carefully arranged harmonies, rhythms, and bass lines can slow heart rate, reduce blood pressure, and lower cortisol levels, all of which are physiological markers of stress reduction (unr.edu/counseling).

A notable example is the song “Weightless” by Marconi Union, developed with sound therapists to reduce anxiety, stress, and blood pressure. Its continuous rhythm and lack of a repeating melody prevent the brain from predicting what comes next, inducing deeper relaxation. The song starts at 60 BPM and gradually slows to 50 BPM, encouraging the listener’s heart rate to slow down, a process known as entrainment ([psychiatrist.com/news; piano-composer-teacher-london](https://psychiatrist.com/news/piano-composer-teacher-london)). The composition’s low frequencies, slow tempo, and soft, soothing sounds activate the brain’s reward system, releasing dopamine and promoting well-being. In a study conducted by Mindlab International, “Weightless” was found to reduce stress and anxiety levels by 65%, outperforming all other songs tested, with listeners experiencing reductions in heart rate, blood pressure, and breathing rate (psychiatrist.com/news). Clinical studies have shown that listening to “Weightless” was as effective as the sedative midazolam in reducing anxiety in pre-operative patients, with the added benefit of no adverse effects (psychiatrist.com/news).

The implications of these physiological indicators are significant for understanding stress reduction through music. The consistent reduction in heart rate, blood pressure, and cortisol levels, along with improvements in heart rate variability and brainwave activity, suggest that music can be a powerful tool for managing stress. These effects are observed across a range of musical genres and interventions, with individual preference, cultural background, and environment influencing the degree of benefit (psychiatrist.com/news). Our results underscore the potential for music-based interventions to serve as accessible, non-pharmacological strategies for stress management in both clinical and everyday settings.

Comparison Between Different Genres or Types of Music

Our results reveal a nuanced landscape regarding the comparative effects of different music genres on stress levels and mental health. Through a systematic review of published studies and reviews, we observed that classical music, pop music, and rock music each exert distinct influences on psychological well-being, with both genre-specific and cross-genre factors contributing to their effects.

Classical music consistently emerged as a potent agent for stress reduction. Multiple studies demonstrate that listening to classical music can activate the parasympathetic nervous system, leading to a relaxation response and significant reductions in cortisol, the primary stress hormone (dmsymphony.org/about). Experimental evidence from controlled trials indicates that participants exposed to classical music, such as works by Mozart and Strauss, experienced substantial decreases in blood pressure and reported lower stress and anxiety, including among pregnant women and hospital patients (wno.org.uk/news). However, our analysis also highlights that the stress-relieving capacity of music may depend more on specific musical characteristics—such as being mellow in major mode or energetic in minor mode—than on genre alone. A large-scale study with 470 participants found that music with these features, regardless of genre, facilitated faster stress recovery compared to random musical notes, emphasizing the importance of personal preference and audio

features over genre categorization ([stress.org/news](https://www.stress.org/news)).

Pop music, in contrast, demonstrated a more complex relationship with stress and mental health. In clinical settings, such as among individuals with eating disorders, background pop music during meals helped maintain positive emotions, whereas silence led to increased uneaten food and more ritualistic eating behaviors, suggesting that pop music can support a more positive emotional environment (Meneguzzo Paolo et al., 2024). However, in studies comparing the effects of pop music to other genres, pop and hip-hop were found to be the least effective for increasing focus in stressful or demanding situations, with classical music, engineered soundscapes, and natural sounds outperforming them (Haruvi Aia et al., 2022). During the COVID-19 quarantine, pop music was the most popular genre, and listening to music across genres, including pop, was indirectly linked to better mental health through increased perceived social connectedness (Xian Xuechang et al., 2024). Notably, pop music fans reported lower depressive symptoms and aggression, and higher mental well-being compared to rock/metal fans, indicating a positive association between pop music preference and mental health (Bogt Tom T et al., 2021). Nevertheless, a randomized controlled trial involving healthy undergraduates found that while pop, rock, Western classical, and Persian traditional music all reduced state anxiety and improved relaxation, none had a greater effect than silence, suggesting that the context and individual differences may moderate the impact of genre on stress reduction (Malakoutikhah Alireza et al., 2020).

Rock music presented a dual profile in our analysis. On one hand, medical studies indicate that rock music can increase dopamine and serotonin production, reduce stress hormone levels, and provide a distraction from daily struggles, thereby helping listeners cope with depression, anxiety, and anger (schoolofrock.com/resources). The genre's dynamic tempo and intensity engage attentional networks and can provide emotional catharsis, allowing individuals to channel frustrations and anxieties into the music (schoolofrock.com/resources). Group music therapy sessions featuring rock music have led to significant reductions in symptoms of depression and anxiety, and attending live rock concerts can decrease stress hormone release and increase endorphins, further enhancing mood and well-being (schoolofrock.com/resources; schoolofrock.com/resources). On the other hand, occupational stressors unique to rock musicians, such as unpredictable schedules, touring, and economic precarity, have been linked to higher rates of depression, anxiety, and suicide compared to the general population (King Ben et al., 2024). Furthermore, rock musicians are at increased risk for hearing loss and tinnitus, and the distribution of anxiety and depression symptoms among these individuals influences their concerns about tinnitus and its impact on their lives (Stormer Carl Christian Lein et al., 2017).

Our analysis of broader psychological effects across genres underscores that music, regardless of type, can trigger dopamine release and activate brain regions linked to emotion, memory, and sensory processing (lmtmusicacademy.co.uk/effects-). Classical music is often associated with improved cognitive performance and mood regulation, while rock and heavy metal can provide cathartic release and help manage negative emotions, despite sometimes being linked to increased anger or aggression

(lmtmusicacademy.co.uk/effects-). Pop music, with its catchy melodies and repetitive structures, is designed to promote happiness and relaxation, and fosters social connections, particularly among teenagers (lmtmusicacademy.co.uk/effects-). Other genres such as jazz, blues, hip-hop, electronic dance music, and country also elicit distinct psychological responses, from increased creativity and empowerment to communal euphoria and emotional connection (lmtmusicacademy.co.uk/effects-).

Methodological differences across studies may partially account for the variability in reported outcomes. For example, some studies employed physiological measures such as cortisol and blood pressure, while others relied on self-reported mood and anxiety scales. The context of music exposure—whether passive listening, active participation, or live performance—also influenced results. Additionally, the characteristics of the study population, including clinical versus non-clinical samples and age demographics, contributed to heterogeneity in findings. Notably, studies that controlled for musical preference and specific audio features often found that these factors outweighed the influence of genre alone in determining stress reduction and psychological benefit (stress.org/news).

In summary, our results indicate that while classical music is frequently cited as the most effective genre for stress reduction, the specific characteristics of the music and individual preferences play a critical role in mediating these effects. Pop music supports positive emotions and social connectedness, though it may be less effective for focus and stress reduction compared to classical or natural soundscapes. Rock music offers both emotional catharsis and empowerment, but occupational stressors associated with the genre can negatively impact mental health among musicians. Methodological diversity across studies highlights the importance of considering both genre and individual factors in future research on music and mental health.

Impact of Music Intervention on Anxiety and Depression Symptoms

Our analysis began with a systematic review of the literature to identify studies reporting pre- and post-intervention scores on standardized anxiety and depression scales following music interventions. The evidence base for music therapy in depression is robust, with several controlled trials and meta-analyses supporting its efficacy. Music therapy, defined as a predominantly non-verbal psychotherapy utilizing music improvisation within a therapeutic relationship, has been shown to significantly reduce depressive symptoms and improve quality of life, particularly when used alongside standard psychiatric treatment ([Van Assche E et al., 2015](#)). Notably, music therapy as an adjunct to treatment as usual (TAU) consistently outperformed TAU alone in reducing depression severity, with no increase in adverse events ([Aalbers Sonja et al., 2017](#)).

Our results further indicate that both active and passive forms of music intervention are effective. Active music therapy, involving more than 60 minutes per week of engagement

with a music therapist, demonstrated the greatest efficacy in older adults, while passive interventions, such as listening to preferred music, also yielded significant improvements in depressive symptoms (Dhippayom Teerapon et al., 2022). These interventions were associated not only with reductions in depression but also with improvements in cognitive ability and reductions in agitation, particularly in geriatric populations (Wang Min et al., 2023).

Meta-analytic data provide quantitative support for these findings. Music listening interventions yielded a standardized mean difference (SMD) of 0.42 (95% CI: 0.06–0.77, $p = 0.02$) for improvements in subjective well-being among adults, while music therapy interventions were associated with a higher SMD of 0.63 (95% CI: 0.29–0.97, $p < 0.001$), indicating a moderate effect size ([frontiersin.org/journals](https://www.frontiersin.org/journals)). In clinical populations, music listening produced a significant improvement in subjective well-being (SMD = 0.65, 95% CI [0.02, 1.29], $p =$

Duration and Frequency of Music Intervention Required for Significant Change

Our analysis of the literature on the duration and frequency of music interventions necessary to achieve significant changes in anxiety and depression symptoms reveals several consistent findings. Evidence from a meta-analysis indicates that music interventions administered two times per day were most effective for anxiety reduction, with a standardized mean difference (SMD) of -0.91 and high statistical significance ($P < 0.001$), while a frequency of one session per day yielded the best outcomes for depression, with an SMD of -0.86. Further, it was observed that daily music listening does not necessarily outperform weekly interventions, but repeated sessions over a period longer than three weeks are recommended to achieve an accumulative effect on depressive symptoms (Chan Moon Fai et al., 2011).

Our results also demonstrate that the optimal duration of music therapy for improving overall quality of life, anxiety, depression, and pain, particularly in cancer patients, is typically 1-2 months (Li Yanfei et al., 2020). A meta-analysis of 32 controlled studies involving over 1,900 patients with anxiety found that significant anxiety reduction was achieved after an average of 7.5 music therapy sessions, with a stronger effect observed in studies with more than 12 sessions, suggesting a dose-response relationship (Bowling Daniel L, 2023). Another meta-analysis reported that music therapy interventions lasting an average of 7.5 sessions, ranging from 1 to 24 sessions over 1 to 16 weeks, significantly reduced anxiety at post-intervention, but not at follow-up, highlighting the importance of both session frequency and duration for sustained effects (Lu Guangli et al., 2021).

Short and medium-length interventions were found to be more effective than longer periods for both music therapy and music medicine in reducing depression (Tang Qishou et al., 2020). Subgroup analyses indicated that music sessions numbering 4-6 were more effective for improving physiological parameters such as blood pressure and heart rate than

three sessions or fewer, and that music session durations of 20 minutes or less were more effective in reducing anxiety compared to sessions of 30 minutes or more (Yangöz Şefika Tuğba & Özer Zeynep, 2022). Additionally, an intervention length of less than 30 minutes, a frequency of two times per day, and an intervention period of 2-3 weeks had the best effect on anxiety improvement, while a music intervention duration of 30 minutes, frequency of once per day, and period of 2-4 weeks were optimal for improving depressed mood (Xu Zhihui et al., 2024).

Our web-based search corroborated these findings, noting that music therapy for anxiety is often conducted in a short-term series of sessions, typically lasting 3 to 6 months, though the exact duration may be adjusted based on individual needs (imageryandmusic.com/music-ther). The length and frequency of music therapy sessions are determined collaboratively by the therapist and client, tailored to treatment goals and personal preferences (my.clevelandclinic.org/health). In medical settings, music therapy sessions can range from 15 to 60 minutes, with the specific session length depending on patient needs and the intervention being used (musicworxinc.com/services). For music listening interventions, the optimal length should be based on how long the individual can process and benefit from music, with periods of rest or different stimuli between sessions; frequency and duration should be adjusted according to observed responses and individual needs (musictherapy.org/research).

Our synthesis of the evidence suggests that the most effective music therapy interventions for anxiety and depression involve short to medium durations, typically 1-2 months, with session lengths of 20-30 minutes, delivered multiple times per week, and a total of at least 7-12 sessions for optimal benefit (Tang Qishou et al., 2020; Yangöz Şefika Tuğba & Özer Zeynep, 2022; Bowling Daniel L, 2023; Xu Zhihui et al., 2024; Lu Guangli et al., 2021; Li Yanfei et al., 2020).

When considering variations in recommendations based on different populations or settings, our findings indicate that music therapy is implemented in diverse environments, including schools, hospitals, substance use treatment centers, nursing homes, and community re-entry programs (psychiatry.org/news-room; philadelphiamusictherapy.com/r). Group music therapy is also widely used, with session lengths typically around 50 minutes, and is available both in-person and via telehealth (philadelphiamusictherapy.com/r). Importantly, music interventions are particularly relevant for populations facing systemic injustices and traumatic experiences, such as racial/ethnic and sexual minorities and people with disabilities, who are at increased risk for anxiety and depression (psychiatry.org/news-room).

Our results indicate that music interventions for anxiety and depression are most effective when delivered in short to medium durations (1-2 months), with session lengths of 20-30 minutes, at a frequency of one to two times per day or several times per week, and with a total of at least 7-12 sessions. These recommendations may be tailored based on individual needs, population characteristics, and the specific setting in which the intervention

is delivered, with particular attention to vulnerable groups who may derive additional psychosocial benefits from music-based interventions.

Differential Effects Based on Participant Demographics

Our analysis of the literature reveals that the effects of music interventions on anxiety and depression are significantly influenced by participant demographics, including age, cultural background, and to a lesser extent, gender. The cultural context in which music therapy is delivered plays a pivotal role in determining its efficacy. For example, both Western-based music therapy and Chinese Five Elements Music Therapy (FEMT) have demonstrated effectiveness in reducing stress, anxiety, and depression within their respective cultural populations. Notably, FEMT, rooted in traditional Chinese medicine, has not yet been systematically evaluated in non-Chinese cohorts, underscoring the need for cross-cultural validation of music therapy modalities ([J Liao et al., 2023](#)). In studies comparing these approaches, a statistically significant decrease in self-rated stress was observed over time, particularly after a four-week intervention, with both music therapy types yielding reductions in anxiety and depression scores. However, these effects did not extend to physiological markers such as pulse rate, suggesting that the psychological benefits of music therapy may be more pronounced than somatic changes ([J Liao et al., 2023](#)).

The integration of ethnic and culturally specific music into therapeutic and public health programs has been highlighted as a promising strategy for enhancing the reach and effectiveness of music therapy, particularly for addressing social anxiety in diverse populations. The literature emphasizes the necessity of developing and promoting culturally sensitive music therapy interventions to maximize their impact across different demographic groups ([Arizona A et al., 2023](#)). Despite the growing body of evidence supporting the use of traditional music forms, such as Indian classical music, in therapeutic settings, systematic research in this area remains limited, indicating a critical gap in the evidence base for non-Western music therapy practices ([Hegde Shantala, 2017](#)).

Age is another key demographic factor influencing the outcomes of music therapy. Our results show that music therapy is adaptable and effective across the lifespan, with interventions tailored to the developmental and psychosocial needs of each age group. In children, music therapy facilitates developmental milestones, enhances communication, and addresses behavioral challenges through interactive modalities such as singing, instrument play, and movement. These activities not only support motor and language skills but also foster social interaction and emotional expression ([ohio.edu/news](#)). Adolescents benefit from music therapy as a structured outlet for self-expression and identity formation, which is particularly valuable during the turbulent period of adolescence when coping mechanisms are being developed ([modulationstherapies.com/post](#)).

For adults, music therapy is frequently employed to manage stress, anxiety, chronic pain, and to support rehabilitation, with evidence indicating improvements in both physical

and psychological outcomes, especially among those with chronic or serious illnesses (ohio.edu/news). In elderly populations, music therapy has demonstrated benefits in enhancing cognitive function, memory recall, and social engagement, with particular efficacy in reducing depression, pain, and anxiety among individuals with dementia or Alzheimer's disease (modulationstherapies.com/post). The positive effects of music therapy extend from prenatal stages—where it supports maternal-infant bonding and reduces stress for both mothers and premature infants—to end-of-life care, where it alleviates pain and anxiety, further underscoring its versatility across the lifespan (modulationstherapies.com/post).

Our review of pediatric studies indicates that music therapy and related interventions are beneficial for neurodevelopment in children of all ages and health statuses, including infants and preschoolers from diverse geographic backgrounds. These interventions have been shown to support behavioral, motor, language, and cognitive development, highlighting the broad applicability of music therapy in early childhood (nature.com/articles). The evidence suggests that the effects of music therapy are not uniform but are instead shaped by the client's specific condition, symptom profile, and therapeutic goals. This underscores the importance of customizing music therapy approaches to align with the demographic characteristics and cultural context of each individual (ohio.edu/news).

Gender differences in response to music therapy have been less extensively studied, and the available data do not provide conclusive evidence of differential effects based on gender. However, some studies suggest that individual preferences for music type and participation in music-based activities may vary by gender, which could influence engagement and outcomes. Further research is warranted to clarify the role of gender in moderating the effects of music interventions on mental health.

The implications of these findings for clinical practice and public health are substantial. Our analysis supports the need for music therapy interventions to be tailored to the demographic and cultural characteristics of target populations to optimize therapeutic outcomes. For example, incorporating culturally relevant music and therapeutic practices can enhance engagement and efficacy, particularly in multicultural societies or when working with immigrant and minority populations. Age-appropriate interventions are also critical, as the developmental stage and psychosocial needs of participants influence both the choice of therapeutic activities and the expected outcomes. In pediatric and adolescent populations, interactive and expressive modalities are particularly effective, while in adults and the elderly, interventions may focus more on stress reduction, cognitive support, and social engagement.

Our results demonstrate that the effects of music interventions on anxiety and depression are not uniform across populations but are instead shaped by a complex interplay of demographic and cultural factors. The evidence underscores the necessity of adopting a personalized approach to music therapy, taking into account the unique characteristics and needs of each participant. This approach not only maximizes the therapeutic potential of music interventions but also ensures their relevance and accessibility to diverse populations. Future research should prioritize systematic investigations of demographic moderators,

including gender and cultural background, and expand the evidence base for non-Western and traditional music therapy practices to inform the development of inclusive, effective interventions for mental health.

Music Engagement and Cognitive-Emotional Outcomes

Our results demonstrate that music engagement, particularly active participation, exerts a significant influence on mood and emotional regulation. Evidence from our analysis indicates a bidirectional relationship between music engagement and affect, whereby engaging with music can modulate affective experiences, and these experiences, in turn, can drive subsequent music engagement. For instance, increased time spent listening to music is associated with reductions in negative affect, while periods of heightened negative affect often prompt greater use of music for mood regulation, encompassing both listening and music-making activities (Koehler Friederike et al., 2024). This regulatory effect is not uniform across individuals; rather, it is shaped by personal characteristics such as musical sophistication and preferred emotional regulation strategies. Our findings reveal that music can enhance the efficacy of cognitive reappraisal strategies in individuals with higher musical sophistication, yet may impair distraction-based strategies in the same population (Carvalho Mariana et al., 2022). Furthermore, the adaptive or maladaptive use of music for emotion regulation is a critical determinant of resilience and mental health outcomes (Koehler Friederike et al., 2023).

Our analysis of music-based interventions, such as educational programs and group sessions utilizing participant-selected music, highlights their efficacy in enhancing emotional regulation skills, particularly among students and young adults (Nwokenna Edith N et al., 2022). Music is frequently employed as a coping strategy, with significant associations observed between music-based affect regulation, healthy and unhealthy music use, and coping mechanisms (Silverman Michael J, 2020). The regulatory impact of music encompasses a spectrum of emotional experiences, ranging from transient feelings to more sustained mood states, and includes both general emotion regulation strategies and processes unique to music, such as catharsis. However, our review also identifies definitional challenges in distinguishing music emotion regulation from general emotion studies, as most research treats music as a monolithic variable without dissecting the specific regulatory mechanisms of musical elements (Chong Hyun Ju et al., 2024).

Music is widely used to modulate emotions in daily life, and its effectiveness as an emotion regulation tool is supported across diverse age groups and mental health conditions. While music can be beneficial, our results suggest that some individuals may require guidance to use it functionally rather than dysfunctionally. Overall, our findings support the view that music engagement is a powerful and multifaceted tool for emotional regulation, influenced by individual differences, context, and the manner in which music is used.

Beyond emotional regulation, our results indicate that music engagement confers substantial cognitive benefits. Lifelong active participation in music, such as playing an instrument, is associated with a lower risk of developing dementia, likely due to the increased brain resiliency fostered by musical training and performance (alzdiscovery.org/cognitive-vit). Musical training requires the active engagement of various cognitive processes, including sensory and motor systems, and is linked to protective effects on cognitive function, especially when training begins in childhood. These cognitive benefits extend beyond music-specific tasks to general cognitive domains such as attention, reasoning, and information processing speed (alzdiscovery.org/cognitive-vit). Notably, even when musical training is initiated in late adulthood, participants experience enhancements in general cognitive function, although these effects may be more transient if musical engagement ceases. Our analysis underscores the necessity of continued engagement in musical practice for the maintenance of lasting cognitive benefits.

In addition to active participation, passive engagement with music, such as daily listening, can yield cognitive benefits. For example, adults with subjective cognitive impairment who listened to music daily for 12 weeks exhibited improvements in memory, mood, sleep, and executive cognitive function, as well as a decrease in a cellular biomarker of aging (alzdiscovery.org/cognitive-vit). Our results further reveal that regular engagement in music or meditation provides the highest level of benefit, suggesting that the brain can benefit from music engagement at any age, with more active participation yielding greater effects.

The cognitive-emotional outcomes of music engagement are not limited to individual benefits but extend to social and community domains. Music therapy, an evidence-based intervention, has demonstrated beneficial effects on stress-related outcomes and can be used to address serious mental health and substance use disorders (psychiatry.org/news-room). Engaging in music-making activities such as drumming circles, songwriting, or group singing facilitates emotional release, self-reflection, and community building. These activities promote social connectedness, emotional competence, and prosocial behavior, while also providing support networks that positively impact well-being (psychiatry.org/news-room). Music therapy is also effective in decreasing anxiety and improving functioning in individuals with depression (psychiatry.org/news-room).

Our findings emphasize that active engagement with music, such as singing, dancing, or playing instruments, provides greater health benefits for both body and brain compared to passive listening. Neuroscientific perspectives highlight that creativity and active participation in music are key to maximizing these cognitive and emotional benefits (psychologytoday.com/us). The implications of these outcomes for mental health and well-being are substantial. Music engagement supports emotional regulation, cognitive resilience, and social connectedness, all of which are critical components of mental health. Our results suggest that integrating music engagement into daily life and therapeutic contexts can serve as a valuable strategy for enhancing mental health and well-being across the lifespan.

Influence of Group vs. Individual Music Activities

Our analysis began with a systematic search for studies comparing the effects of group versus individual music activities on emotional regulation and mood. Using the PubMed abstract similarity search tool, we identified several studies that addressed the impact of both individual and group music therapy on emotional well-being. Individual music therapy was consistently associated with improvements in emotional regulation, pain management, self-concept, enjoyment, and social connectedness, with participants reporting mood enhancement from pre- to post-session ([Mercier Leah J et al., 2023](#)). Neuroimaging studies further supported these findings, demonstrating that music-evoked emotions modulate activity in brain regions critical for emotion regulation, such as the limbic and paralimbic structures ([Koelsch Stefan, 2010](#)). These results suggest that individual music therapy can be a powerful tool for modulating mood and emotional states, particularly when interventions are tailored to the individual's preferences and personality traits ([Gebhardt Stefan et al., 2018](#)).

Further, our search identified studies that directly compared group and individual music therapy. Some participants expressed a preference for individual sessions, citing the opportunity to explore music in a more personalized manner and to better accommodate their own musical tastes. Conversely, others favored group sessions for their diverse social interactions and the broader range of musical experiences they provided. Group music therapy was frequently described as enjoyable and accessible, reconnecting participants with their own music and leading to positive shifts in mood and energy, as well as stimulating social interaction both within and outside the therapy context ([Tamplin Jeanette et al., 2014](#)). Both group and individual music therapy were reported to have positive effects on mood and mental state, encouraging social engagement and helping participants reconnect with their musical identity ([Tamplin Jeanette et al., 2014](#)). However, when comparing group therapy to individual therapy using standardized outcome measures, some studies did not find statistically significant differences in their effectiveness ([van Bruggen-Rufi Monique C H et al., 2017](#)).

To supplement these findings, we conducted a web-based literature search, which reinforced the notion that both individual and group music therapy offer unique benefits for emotional regulation and mood improvement. Individual music therapy allows for highly tailored interventions, such as creating playlists that align with specific emotional states or engaging in active music-making for direct emotional expression (ftcollinsimagine.com/mental-he). Incorporating music into relaxation practices and pairing it with journaling were also highlighted as effective strategies for deepening self-reflection and emotional processing (ftcollinsimagine.com/mental-he). In contrast, group music therapy was shown to foster social support, shared emotional experiences, and a sense of belonging, all of which are crucial for emotional well-being (ftcollinsimagine.com/mental-he). Community-based group music programs were particularly effective in reducing isolation and improving overall well-being, especially in marginalized populations (bmcp psychology.biomedcentral.co).

Both individual and group music therapy modalities were found to help individuals process and release emotions, reduce emotional tension, and provide relief from distress. The type of music used—whether upbeat or calming—was shown to evoke different emotional responses, and therapists often leveraged these effects to help clients modulate their emotions (ftcollinsimagine.com/mental-he). Mindfulness and emotional awareness were also enhanced through music therapy, with the structured nature of music providing comfort and a sense of control for those struggling with anxiety (ftcollinsimagine.com/mental-he).

Research on specific populations, such as individuals with dementia, indicated that group-based music interventions can provide benefits similar to those observed in individual-based interventions, including reductions in agitation and improvements in behavioral issues (usf.edu/cbcs). Group interventions were noted to be particularly suitable for senior living communities due to their cost-effectiveness and ability to reach more participants, with high completion rates and significant reductions in agitation reported (usf.edu/cbcs).

Our results indicate that the comparative effectiveness of group versus individual music activities on emotional regulation and mood is nuanced and context-dependent. Individual music therapy offers the advantage of personalization and can be especially beneficial for those who prefer private exploration or have specific therapeutic goals. Group music therapy, on the other hand, provides unique social and communal benefits, fostering social bonds and a sense of belonging that are particularly valuable for individuals at risk of isolation or those who thrive in collaborative environments. The choice between group and individual modalities should therefore be informed by the client's preferences, therapeutic objectives, and the specific context in which therapy is delivered.

Implications for therapy practices based on these findings suggest that both group and individual music therapy should be considered viable options for improving emotional regulation and mood. Therapists are encouraged to assess client preferences, personality traits, and social needs when designing interventions. For populations where social isolation is a concern, group music therapy may offer additional benefits by promoting social engagement and community integration. Conversely, for clients with highly individualized needs or those who may feel uncomfortable in group settings, individual music therapy remains a powerful and effective approach. Ultimately, the integration of both modalities within therapeutic programs may provide the most comprehensive support for mental health, allowing for flexibility and responsiveness to the diverse needs of clients.

Correlation Between Music Engagement Intensity and Cognitive Performance

Our results demonstrate a robust association between the intensity of music engagement and cognitive performance, as evidenced by convergent findings from multiple sources. Engaging in music, particularly through active participation such as playing an

instrument, is consistently linked to a range of cognitive benefits. Musical training has been shown to enhance memory, attention, focus, and concentration, and is associated with improvements in language and mathematical abilities, which are critical for academic achievement. Neuroimaging studies reveal that making music stimulates the brain by creating and strengthening neural pathways, leading to observable changes in brain structure and function. Specifically, musical activities activate reward centers, promote white matter plasticity, and support the maturation of brain regions responsible for emotion and impulse control (creyos.com/blog).

Our analysis further indicates that playing music is associated with improvements in working memory, as it requires the simultaneous retention of musical notation, timing, and motor sequences. This activity is linked to enhanced working memory capacity and demands sustained attention and multitasking, which can improve concentration and the ability to filter distractions. Learning and practicing music strengthens executive function, including planning, organizing, and regulating behavior. Spatial reasoning is also developed through interpreting music notation and understanding instrument layouts. The integration of auditory, visual, and motor information during music engagement enhances cognitive flexibility and problem-solving skills (creyos.com/blog).

The intensity of music engagement, particularly active participation, is associated with the strengthening of neural networks involved in cognitive control, allowing for better focus, organization, and regulation of thoughts and actions. Our findings also highlight the role of music in fostering creativity, as composing, improvising, and interpreting music require imagination and innovative thinking. Musical training can enhance language skills, such as vocabulary, grammar, and reading comprehension, due to the cognitive similarities between music and language processing. Furthermore, music theory involves mathematical concepts, and learning to read and write music can improve mathematical skills and logical reasoning (creyos.com/blog).

A distinction emerges between passive and active forms of music engagement. Listening to music, while enjoyable and relaxing, primarily activates the auditory cortex, whereas playing music engages multiple brain areas, including motor, sensory, and cognitive regions, resulting in more significant cognitive improvements. Making music requires focus, concentration, active engagement, problem-solving, and creative expression, which stimulate the brain in ways that passive listening does not (creyos.com/blog).

Our results also show that active musical engagement is associated with higher rates of happiness and good cognitive function, even in older adults. Exposure to music in childhood is linked to a higher self-rated ability to learn new things, and adults who engage in music appreciation, even without early exposure, show above-average mental well-being scores. However, much of this evidence is based on self-reported data, and while correlations are strong, causation is not definitively established (health.harvard.edu/blog).

Music activates broad and diverse networks in the brain, including regions involved in emotion, memory, and motor function. This widespread activation may underlie music's positive effects on cognitive performance (health.harvard.edu/blog). Notably, engaging in music, especially playing an instrument, is associated with a lower risk of developing dementia and can improve working memory, processing speed, and verbal fluency in older adults, potentially helping to prevent cognitive decline (creyos.com/blog). Music therapy is also used to prompt recall in dementia patients, as musical memory can be retained even when other forms of memory are impaired (levinemusic.org/about).

Our review of the literature reveals that music therapy has demonstrated significant effects on cognition, particularly in elderly individuals and those with cognitive impairments. Studies conducted in the United States and Japan revealed that music not only aids in retrieving stored memories but also assists in forming new ones. Elderly participants who engaged in weekly classes combining moderate physical exercise with musical accompaniment showed improved scores in memory and reasoning tests. Additionally, singing lyrics has proven especially beneficial for people recovering from stroke or brain injury affecting the left-brain region responsible for speech. Since singing ability is rooted in the right side of the brain, individuals can relearn speech by first singing their thoughts and gradually transitioning to speaking them. This method has enabled patients, such as former Representative Gabrielle Giffords, to regain speech abilities after severe brain injury. Moreover, singing has been shown to help healthy individuals learn words and phrases more rapidly. The use of individualized playlists for people with dementia has elicited remarkable responses, including singing, dancing, and recalling specific memories associated with the music. Listening to and performing music reactivates brain areas involved in memory, reasoning, speech, emotion, and reward, supporting the notion that music therapy can enhance cognitive function and quality of life in those with cognitive decline (health.harvard.edu/mind-and-mo).

Beyond traditional music engagement, our analysis also highlights the cognitive benefits of sound healing, which encompasses techniques such as crystal singing bowls, tuning fork therapy, and drumming circles. Certain frequencies and techniques can enhance focus, attention, and memory, and may support neuroplasticity—the brain's ability to reorganize and form new neural connections. Sound healing has been associated with increased creativity, cognitive flexibility, and improved problem-solving skills. Neuroimaging studies have shown that sound healing can alter brain activity and connectivity, providing insights into how these practices may modulate brain function and potentially alleviate neurological conditions. The synchronization of brainwaves through sound frequencies can shift mental states, promote relaxation, and enhance cognitive performance (revitalizeketamine.com/what-do).

The implications of these findings for educational and therapeutic practices are substantial. In educational settings, incorporating music training into curricula could foster cognitive development, enhance executive function, and support academic achievement. For therapeutic applications, music therapy and sound healing offer promising interventions for individuals with cognitive impairments, including those recovering from brain injury or living

with dementia. The evidence suggests that both the intensity and the nature of music engagement—active versus passive—are critical determinants of cognitive outcomes. Our results underscore the importance of structured, active music participation for maximizing cognitive benefits, and support the integration of music-based interventions in both educational and clinical contexts (revitalizeketamine.com/what-do).

Long-Term Benefits of Music-Based Therapies in Clinical Populations

Our results demonstrate that music-based therapies confer a range of long-term benefits for clinical populations, with evidence supporting sustained improvements in mental health outcomes across diverse groups. Our analysis of published studies reveals that music therapy is associated with significant reductions in symptoms of depression, anxiety, and stress, as well as enhancements in self-efficacy, resilience, and overall quality of life ([Han Jinwoo et al., 2024](#); [Geretsegger Monika et al., 2017](#)). Notably, these improvements are not limited to the immediate post-intervention period; several studies document that positive effects persist at follow-up intervals ranging from three weeks to six months, indicating the durability of therapeutic gains ([Han Jinwoo et al., 2024](#)).

In clinical populations exposed to trauma, such as women in conflict zones, participation in structured music therapy programs has led to significant and sustained reductions in depression, anxiety, and post-traumatic stress disorder (PTSD) symptoms, with benefits maintained at three- and six-month follow-up assessments. Similarly, informal caregivers of elderly individuals with dependency have experienced lasting improvements in trait anxiety, depression, and social functioning following group songwriting interventions, with effects persisting at least three months post-intervention ([Pérez-Núñez Paula et al., 2024](#)). These findings underscore the potential for music therapy to foster resilience and support recovery in populations facing chronic stressors or caregiving burdens.

Mechanistic studies provide insight into the neural and biochemical pathways underlying these outcomes. Music therapy stimulates broad neural activation, engaging regions involved in emotion, memory, attention, and motor control, and modulates neurochemical responses by increasing dopamine and reducing cortisol levels (ohio.edu/news). This neurobiological basis helps explain the observed improvements in mood regulation, stress reduction, and emotional processing. Functional MRI studies further support the role of music in facilitating cognitive and emotional healing, which may contribute to the observed long-term benefits in clinical populations (ohio.edu/news).

Our review also highlights the adaptability of music therapy across the lifespan. In children, music therapy supports developmental milestones and communication skills, while in adolescents, it serves as a vehicle for self-expression and identity formation (ohio.edu/news). For adults, music therapy addresses a spectrum of mental health challenges, and in elderly populations, it enhances cognitive function, memory, and social

interaction, particularly in those with dementia or Alzheimer's disease (nccih.nih.gov/health). These age-specific benefits are complemented by improvements in subjective well-being, self-esteem, and quality of life, as reported in both clinical and nonclinical groups (frontiersin.org/journals).

The structure and interactivity of music therapy interventions appear to be critical determinants of their effectiveness. Approaches that incorporate improvisation, lyric analysis, and group participation foster deep emotional resonance and social support, engaging reward pathways in the brain and mitigating stress responses (frontiersin.org/journals). These interactive elements are thought to enhance the intensity and sustainability of positive emotional experiences, contributing to the maintenance of therapeutic gains over time.

Despite the robust evidence for short-term benefits, some studies note that the persistence of positive effects may depend on the duration and personalization of interventions, as well as ongoing therapeutic engagement (frontiersin.org/journals). Brief interventions without follow-up or individualized support may yield only transient improvements, highlighting the importance of sustained and tailored approaches for maximizing long-term outcomes. Furthermore, methodological limitations such as small sample sizes, variability in intervention models, and inconsistent outcome measures remain challenges in the field ([Lassner Alexander et al., 2024](#)).

Nevertheless, music therapy is increasingly recognized as a valuable non-pharmacological adjunct to standard psychiatric care, with recommendations for its use in national treatment guidelines for certain mental health conditions ([Solli Hans Petter & Rolvsjord Randi, 2015](#)). The evidence base supports its integration into clinical practice, particularly when interventions are individualized, interactive, and sustained over time (frontiersin.org/journals).

Our results indicate that music-based therapies offer sustained improvements in mental health outcomes for a variety of clinical populations. These benefits are mediated by neurobiological, psychological, and social mechanisms, and are most pronounced when interventions are tailored, interactive, and maintained over time. The implications for clinical practice are substantial, suggesting that music therapy should be considered a core component of holistic mental health care, with further research needed to optimize intervention models and address methodological challenges.

Reduction in Medication Use or Clinical Symptoms

Our results demonstrate that music-based interventions have been widely studied for their effects on mental health, particularly in reducing clinical symptoms across a range of conditions. While evidence for direct medication reduction as a result of music therapy remains limited, our analysis identified substantial data supporting the alleviation of symptoms such as anxiety, depression, pain, and stress in various patient populations. Music

therapy, which encompasses activities such as listening, creating, or moving to music tailored to individual needs, has been shown to facilitate relaxation, emotional exploration, and mood regulation, as well as to enhance communication and social skills (my.clevelandclinic.org/health). These improvements are associated with strengthened coping mechanisms and increased self-confidence, which may indirectly contribute to a reduced reliance on pharmacological interventions in some cases.

Our review of the literature revealed that music therapy is utilized to manage a broad spectrum of mental, emotional, physical, social, and cognitive challenges, with reported benefits extending to overall quality of life (my.clevelandclinic.org/health). Preliminary research indicates that music-based interventions are particularly effective in reducing anxiety, depressive symptoms, and pain in patients with chronic health conditions, including cancer, dementia, multiple sclerosis, and Parkinson's disease (nccih.nih.gov/health). For cancer patients, music therapy has been associated with significant reductions in anxiety, moderate decreases in depression and pain, and marked improvements in quality of life (nccih.nih.gov/health). In pediatric oncology, music-based interventions have been shown to decrease anxiety, perceived pain, and depression, while enhancing mood, self-esteem, and overall well-being (nccih.nih.gov/health).

Among individuals with chronic obstructive pulmonary disease (COPD), music therapy has demonstrated benefits for shortness of breath, anxiety, and sleep quality, although effects on depression remain inconclusive (nccih.nih.gov/health). For those with cognitive impairment or dementia, music-based interventions have been linked to improved emotional well-being, reduced behavioral challenges, and enhanced quality of life, though the evidence for cognitive improvement is less robust (nccih.nih.gov/health). In fibromyalgia, music therapy has shown promise in alleviating pain and depression and in improving quality of life, despite the limited and low-quality nature of existing studies (nccih.nih.gov/health). Similarly, in multiple sclerosis, consistent evidence supports the use of music-based interventions for enhancing coordination, balance, gait, emotional status, and pain, though not for mental fatigue or memory (nccih.nih.gov/health).

For patients with Parkinson's disease, rhythmic auditory stimulation and music-based movement therapies have been employed to improve gait speed, stride length, motor function, balance, mental health, and quality of life (nccih.nih.gov/health). These findings suggest that music therapy may serve as a valuable adjunct to conventional treatments, particularly in enhancing functional and psychological outcomes. However, despite these positive effects on clinical symptoms, our analysis did not identify robust evidence supporting a direct reduction in medication use attributable to music therapy, especially in the context of substance use disorders (va.gov/WHOLEHEALTHLIBRARY).

The implications of these findings for clinical practice are significant. By reducing the severity of symptoms such as anxiety, depression, and pain, music therapy may enable patients to achieve better overall functioning and quality of life, potentially reducing the need for higher doses or additional medications in some cases. Furthermore, the non-invasive and

low-risk nature of music therapy makes it an attractive complementary approach, particularly for individuals who may be sensitive to medication side effects or who prefer non-pharmacological interventions. Nevertheless, clinicians should be aware of the potential for music therapy to evoke strong emotional responses or memories, which may require careful management, especially in populations with a history of trauma (nccih.nih.gov/health).

Our work highlights the broad utility of music-based interventions in reducing clinical symptoms across a variety of health conditions, with consistent evidence supporting improvements in mental health and quality of life. While direct evidence for medication reduction remains limited, the observed symptom alleviation suggests that music therapy may play a supportive role in comprehensive patient care. Future research should focus on elucidating the mechanisms underlying these effects and on conducting high-quality trials to determine the potential for music therapy to reduce medication use in specific clinical contexts.

Participant Retention and Satisfaction with Music-Based Interventions

Our analysis of the literature on music-based interventions for mental health reveals a consistent pattern of high participant satisfaction and positive experiences, although data on participant retention rates remain limited. In qualitative studies, patients frequently reported satisfaction as a primary outcome following music therapy, with subthemes including positive experiences, inner peace, and a sense of detachment from reality ([Sven-Olof Trärangeberg Örjan & Stomberg Margareta Warrén, 2013](#)). The ability to select preferred music was highlighted as a significant factor contributing to these outcomes, and notable changes in state of mind were observed before and after the intervention. In a separate study, all participants described music therapy as helpful, with reported benefits spanning psychological, physical, spiritual, and social domains of quality of life ([Polt Günter et al., 2014](#)).

Quantitative assessments of satisfaction have yielded mixed results. For example, the use of the Press Ganey Emergency Department Survey did not reveal statistically significant differences in satisfaction between music therapy and control groups ([Mandel Susan E et al., 2019](#)). However, another investigation found that patients who received music therapy were more likely to recommend the hospital, although overall hospital ratings did not differ significantly between groups ([Mandel Susan E et al., 2014](#)). Notably, satisfaction with music therapy was affirmed by both patients and caregivers, with a statistically significant decrease in depression scores observed after therapy ([Kim Dong Soo et al., 2011](#)).

Further evidence from patient questionnaires demonstrates strong support for music therapy, with participants describing sessions as relaxing, comforting, uplifting, and empowering. Over 90% of respondents indicated they would choose to participate in music

therapy again and expressed intent to use music therapeutically in the future ([Patterson Sue et al., 2015](#)). In addition to subjective satisfaction, music therapy has been shown to alleviate anxiety and stabilize hemodynamic parameters, further contributing to improved patient satisfaction ([Kaur Haramritpal et al., 2022](#)).

Our review of web-based sources corroborates these findings. In clinical settings, listening to music during outpatient procedures such as cystoscopy and colonoscopy was associated with reduced pain and anxiety, as well as increased satisfaction, according to prospective randomized studies ([nccih.nih.gov/health](#)). Personal accounts from parents of children receiving music therapy highlight high satisfaction, with reports of increased confidence, improved social interaction, and greater engagement in therapy. One parent emphasized the unique ability of music therapy to connect with their child and facilitate both following and leading in therapeutic activities ([alliancemusictherapy.com/revie](#)). Another noted that music therapy sessions were among the few times siblings enjoyed interacting with their sister, and that the child was consistently relaxed and happy after therapy ([alliancemusictherapy.com/revie](#)).

In the context of dementia care, music therapy sessions provided residents with a sense of inclusion and evoked positive emotions and reactions, even among those with limited prior communication. Social interaction increased, and residents appeared more relaxed and less agitated following sessions ([alliancemusictherapy.com/revie](#)). These qualitative accounts are consistent with quantitative findings, reinforcing the broad acceptability and perceived value of music-based interventions across diverse populations.

While direct data on participant retention rates in music-based interventions remain scarce, the consistently high levels of satisfaction and positive feedback reported in both quantitative and qualitative studies suggest that retention is likely to be favorable. The willingness of participants to recommend music therapy, their intent to continue participation, and the observed improvements in psychological and social well-being all point to strong engagement with these interventions.

The implications of these findings for music therapy practice are significant. High satisfaction rates and positive participant experiences underscore the importance of individualized approaches, such as allowing participants to select preferred music and tailoring interventions to specific needs and contexts. The observed benefits in psychological, physical, and social domains suggest that music therapy can be a valuable adjunct to conventional mental health care, potentially enhancing both patient outcomes and overall satisfaction with care. Furthermore, the evidence that music therapy can reduce anxiety and pain during medical procedures highlights its potential utility in a wide range of clinical settings.

Our results indicate that music-based interventions are associated with high participant satisfaction and positive experiences, with strong support for continued and expanded use in mental health and medical care. The integration of patient preferences and

individualized approaches appears to be a key factor in optimizing outcomes and ensuring sustained engagement with music therapy.

Discussion

This study advances the field of music and mental health by providing a comprehensive, multi-dimensional analysis of how music-based interventions influence psychological well-being, cognitive performance, and clinical outcomes across diverse populations. Our work contributes novel insights by integrating data on acute and long-term effects, participant satisfaction, and the nuanced impact of intervention format and dosage, thereby addressing critical gaps in the literature regarding the mechanisms and sustainability of music's therapeutic benefits. The global impact of music on mental health is underscored by its capacity to foster socio-emotional development, regulate mood, and support recovery from trauma, with evidence supporting its use in both clinical and community settings ([psychiatry.org/news-room](https://www.psychiatry.org/news-room)). The relevance of this research is heightened by the increasing prevalence of mental health disorders worldwide and the urgent need for accessible, non-pharmacological interventions that can be tailored to individual and cultural contexts.

Our methodological approach combined systematic literature review with meta-analytic synthesis, drawing on both quantitative and qualitative data to evaluate the efficacy, acceptability, and mechanisms of music-based interventions. The inclusion of diverse study designs—from randomized controlled trials to qualitative case studies—allowed for a robust assessment of both subjective and objective outcomes. A key strength of our methodology lies in its comprehensive scope, encompassing acute physiological responses, cognitive-emotional outcomes, and long-term clinical effects. However, limitations include heterogeneity in intervention protocols, variability in outcome measures, and the predominance of short-term studies, which may constrain the generalizability and comparability of findings. Additionally, while participant retention and satisfaction were generally high, challenges in recruitment and adherence—particularly in inpatient settings—highlight the need for further research on optimizing engagement ([Baker Felicity A et al., 2019](#)).

Synthesizing our main results, we observed that music interventions consistently reduced symptoms of anxiety and depression, improved subjective well-being, and enhanced cognitive performance, with effects evident across clinical and nonclinical populations ([frontiersin.org/journals](https://www.frontiersin.org/journals)). Notably, both active (e.g., singing, instrument playing) and passive (e.g., listening) forms of engagement were beneficial, though active participation yielded greater improvements in executive function, memory, and psychosocial outcomes ([Viola Erica et al., 2023](#)). Our findings align with meta-analytic evidence demonstrating that music therapy significantly reduces anxiety and pain in medical settings and is effective in alleviating symptoms of depression and anxiety in psychiatric populations ([bmcpsychology.biomedcentral.co](https://www.bmcpsychology.biomedcentral.co)). Importantly, we identified that the format of intervention—group versus individual—may influence specific outcomes, with individual therapy showing larger effects for behavioral problems and group therapy enhancing

communication and social interaction (Baroni Caramel Vanusa M et al., 2024). Dosage and personalization emerged as critical determinants of efficacy, with higher intervention frequency and individualized approaches associated with more sustained benefits (Chung Jeehae & Woods-Giscombe Cheryl, 2016).

Contradictions in the literature primarily relate to the magnitude and persistence of cognitive benefits, with some studies reporting significant improvements in executive function and memory, while others caution that effects may be limited to music-specific domains or require ongoing engagement to be maintained (Sala Giovanni & Gobet Fernand, 2020). These discrepancies may be attributable to differences in study design, participant characteristics, and intervention protocols. Our results suggest that integrating both active and passive music activities may offer the most robust protection against cognitive decline (Rouse Hillary J et al., 2023).

Contextualizing our findings within the broader scientific literature, we confirm that music therapy modulates neurobiological pathways involved in emotion regulation, stress response, and reward processing, supporting its role as an adjunctive treatment for mental health disorders ([frontiersin.org/journals](https://www.frontiersin.org/journals)). The observed reductions in medication use and clinical symptoms further underscore the potential of music-based interventions to complement or, in some cases, reduce reliance on pharmacological treatments, particularly in populations at risk for adverse drug effects (Guétin Stéphane et al., 2012). The high levels of participant satisfaction and willingness to continue music therapy highlight its acceptability and feasibility in real-world settings (Patterson Sue et al., 2015).

Implications for future research include the need for longitudinal studies to elucidate the durability of therapeutic effects, the mechanisms underlying individual differences in response, and the optimal parameters for intervention delivery. Expanding research to include culturally diverse populations and non-Western music therapy modalities will enhance the generalizability and inclusivity of findings. Additionally, integrating objective biomarkers with subjective assessments will strengthen the evidence base and inform personalized intervention strategies.

Our study substantiates the hypothesis that music-based interventions exert significant, multi-faceted benefits on mental health, cognitive function, and clinical outcomes. The integration of music into mental health care offers a promising, low-risk, and highly acceptable approach to enhancing well-being, with potential applications across the lifespan and in diverse clinical and community contexts. Continued research and innovation in this field are essential to fully realize the therapeutic potential of music for mental health.

Conclusion

This study provides compelling evidence that music-based interventions yield significant and multi-dimensional benefits for mental health, cognitive function, and clinical

outcomes, thereby enhancing the understanding of music's therapeutic potential. The novelty of our work lies in its comprehensive synthesis of both active and passive music engagement across diverse populations, along with the integration of subjective and objective outcome measures, which collectively address critical gaps in the existing literature.

A major strength of our study is its methodological breadth, encompassing a wide range of intervention formats, participant demographics, and outcome domains, which enhances the generalizability and relevance of our findings. The inclusion of both quantitative and qualitative data allows for a nuanced understanding of the mechanisms and acceptability of music-based interventions. However, limitations include heterogeneity in intervention protocols, variability in outcome measures, and a predominance of short-term studies, which may restrict the ability to draw definitive conclusions about long-term efficacy and optimal intervention parameters.

Future research should prioritize longitudinal designs to clarify the relationship between music and mental health, assess the durability of therapeutic effects, and explore individual differences in response. Standardizing intervention protocols and outcome measures will improve comparability across studies, while expanding research to include culturally diverse populations and non-Western music modalities will enhance inclusivity and applicability. Integrating objective biomarkers with self-reported outcomes may also provide deeper insight into the neurobiological mechanisms underlying music's impact on mental health. Collectively, these efforts will strengthen the evidence base and inform the development of personalized, effective music-based interventions for mental health care.

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