Music Therapy App to Treat Parkinson's Disease in Older Men Living in the Area of Cincinnati, Ohio

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Parkinson's Disease (PD) is a progressive neurological disorder that severely impacts movement, mood, and daily functioning. According to the National Center for Health Statistics, in Ohio alone, the disease accounted for 1,565 deaths in 2022, highlighting its growing public health relevance. This paper presents a pre-intervention design study that synthesizes existing research on music therapy and environmental risk factors to guide the development of a mobile music therapy application for older men with PD living in Cincinnati, Ohio. This group is disproportionately affected due to reduced neuroprotective hormonal factors and long term exposure to pollutants associated with the region's industrial past. From prior research on rhythmic auditory stimulation, low-frequency tones, and personalized music interventions, this project outlines how these elements can be incorporated into an accessible, user-centered mobile app. Planned features include AI-driven personalization, optional sensor-based gait and tremor monitoring, and a simplified user interface designed specifically for older adults with motor and cognitive impairments. This study aims to build an evidence-informed foundation for future usability testing and app based music therapy interventions for PD. The goal is to provide an affordable, low risk, and easily accessible alternative to standard PD care for older men in Cincinnati.

Key Words: Parkinson's Disease (PD), Music Therapy, Cognitive, Neural Development

Introduction

Parkinson's Disease (PD) is a progressive neurodegenerative disorder that gradually limits independence and reduces quality of life due to the loss of

dopamine producing neurons in the substantia nigra (Cleveland Clinic, 2025). While direct pharmacological treatments like levodopa can alleviate symptoms, they bring many side effects over time including motor fluctuations and hallucinations. Complementary therapies such as physical therapy and dance therapy have been developed for their potential in enhancing motor function and emotional well-being with no cost for the body (Gilbert, 2021). Music-based therapies have emerged as a particularly promising non-invasive option. Rhythm and melody can activate brain networks involved in movement, timing and emotion and studies suggest that rhythmic auditory stimulation and other structured music interventions may help improve gait, coordination, mood and motivation in people with PD (Siponkoski et al., 2017). These approaches are non-invasive, relatively low cost, and can be adapted to different preferences and abilities (Garcia-Casares et al., 2018). Limited research has explored music therapy tailored to specific demographic and environmental groups, such as older men living in Cincinnati, Ohio. Cincinnati's long industrial history has produced air pollutants like particulate matter and ground level ozone associated with a higher neurological disease risk, making the region a relevant setting for exploring PD. Additionally, PD is more prevalent in men than women, attributed to both hormonal and occupational factors. The average age of onset is around 60 years, placing older men at a particularly high risk. The primary objective of this design and literature-based review is to explore and explain the plan for a mobile music therapy app for men aged 60 and older who live in Cincinnati. This study synthesizes existing scientific literature, demographic data, expert consultations, and early design concepts to build a later formal intervention in the future. The planned app incorporates rhythmic auditory stimulation (like metronomes and rhythmic music), AI personalization, an optimized user interface, low-frequency tones, and personalized music selections with the goal of improving gait, mood, and quality of life in PD (Fan et al., 2023).

Parkinson's Disease: Pathophysiology and Challenges

Parkinson's disease (PD) is primarily caused by the degeneration of dopaminergic neurons in the substantia nigra pars compacta (SNpc), leading to reduced dopamine signaling in the nigrostriatal pathway (Ni et al., 2022). Dopamine released from these neurons normally regulates movement through the basal ganglia-thalamocortical motor pathway, which is in charge of voluntary motor control. As dopaminergic neurons

degenerate, dopamine levels in the basal ganglia decline significantly, thus disrupting movement regulation and producing motor symptoms like tremor, rigidity, bradykinesia, and gait instability (Ni et al., 2022). Research suggests that these neurons are specifically susceptible to oxidative stress and mitochondrial dysfunction due to their high metabolic activity and exposure to reactive oxygen species (ROS) generated during the process of cellular respiration (Guo et al., 2018; Ni et al., 2022). Excess of these ROS can damage many cellular components such as lipids, proteins, and DNA, overall contributing to progressive neuronal degeneration (Guo et al., 2018). Although pharmacological treatments like dopamine replacement therapy through levodopa and neurosurgery like deep brain stimulation (DBS) can improve symptoms, they do not inherently prevent ongoing neuronal degeneration (Ni et al., 2022). Consequently, other complementary therapies including physical rehabilitation, speech therapy, and music therapy have gained special increasing attention as possible approaches to supporting motor function and quality of life in PD individuals.

Neurobiological Mechanisms of Music Therapy in Parkinson's Disease

Music therapy has emerged as having the promising potential to stand as a complementary intervention for many with PD, specifically, through techniques such as rhythmic auditory stimulation (RAS). RAS uses external rhythmic cues such as metronomes or structured musical beats to help synchronize movement and compensate for impaired internal timing caused by basal ganglia dysfunction in the brain (Devlin et al., 2019). In PD, disruptions in dopaminergic signaling normally impair the brain's ability to internally regulate movement timing. This leads to gait disturbances, freezing episodes, and reduced stride length, which contribute to more severe symptoms that individuals may face. By providing consistent external auditory cues, RAS allows individuals to adapt their movements to rhythmic patterns, improving coordination and motor timing overall. Studies using functional MRI (fMRI) have demonstrated that rhythmic auditory cues enhance neural connectivity between many regions involved in movement and timing. These include increased connectivity between the auditory cortex and executive control networks, supporting rhythm processing; the motor cortex and cerebellum, which reinforce external timing mechanisms for movement; and the basal ganglia and premotor cortex, suggesting compensatory activation of motor

planning regions. Because the cerebellum can rely on external auditory cues for movement coordination, music therapy may help bypass the impaired basal ganglia networks by engaging alternative motor pathways.

Neuroimaging studies suggest that rhythmic auditory cues activate many auditory, motor and cerebellar regions that support movement planning and execution (Devlin et al., 2019). Increasing connectivity between the auditory cortex, premotor cortex, and cerebellum allows movement control to rely more heavily on externally guided timing pathways that remain mostly preserved in PD. Additionally, music therapy also engages limbic and paralimbic regions including the amygdala, hippocampus and ventral striatum where the amygdala is involved in emotional regulation and the ventral striatum is involved in reward processing. Because musical engagement activates dopaminergic pathways within the mesolimbic system, it may serve as a strong contributor in also reducing symptoms such as anxiety, depression, and apathy while improving motivation and emotional well-being at the same time (Siponkoski et al., 2017; Garcia-Casares et al., 2018). Specific musical tasks, like rhythmic repetition, melodic intonation, or call-and-response patterns require sensorimotor integration, working memory, and sustained attention. Because of this, they stimulate activation in the frontal, parietal, and temporal lobe, encouraging the brain to stay active and individuals to react more effectively. When looked at together, these neurological advantages suggest that music-based interventions may support both motor rehabilitation and psychological health in PD individuals.

Music Therapy as an Intervention for Parkinson's Disease

Music therapy offers benefits that extend beyond traditional medical treatments for PD. Rhythmic and melodic elements of music engage motor and cognitive pathways, allowing individuals with PD to resume or get back to accomplishing their everyday activities and tasks.

One technique used within the idea of music therapy is rhythmic auditory stimulation (RAS). This strategy utilizes rhythmic cues to enhance motor coordination and gait stability by leveraging the brain's natural ability to synchronize with rhythmic patterns. This trains the brain's motor system to an external beat and causes the auditory cortex to activate neural pathways which are connected to other motor areas, particularly, the cerebellum and basal ganglia. These different regions then work together to accomplish the collective task of regulating movement timing and

improving motor function in conditions where movement control is impaired. Additionally, regularity of auditory stimuli, such as the metronomic beats employed in RAS has been shown to affect reaction times and motor synchronization in a much more positive manner than direct pharmacological treatments (Pando-Naule et al., 2024). Engaging in music-making or listening activities can stimulate areas of the brain involved in handling memory, attention, and executive function. As Pacchetti et. al (2000) measured in a study, participants with PD in the experimental group were exposed to and practiced listening to relaxing music, choral singing, breathing/voice exercises, rhythmic movements, collective improvisation, and body expression to music once a week for 3 months for 2 hours consecutively, while participants with PD in the control group were not. The outcome consisted of improvement in emotional ($P < 0.0001$) and motor ($P < 0.034$) functions, activities of daily living, and quality of life ($P < 0.0001$) in the experimental group. Not much significant difference was found in the control group, indicating music therapy can be useful in aiding symptoms of PD in the brain.

Mobile Health and App-Based Interventions

With the new generation so reliable towards technology, many mobile health (mHealth) technologies have also contributed significantly to the field of healthcare and medicine by providing accessible, cost-effective, and personalized treatment options that can supplement traditional therapies. These benefits are even more useful for our target group, older Parkinson's Disease individuals, as they face transportation barriers, limited mobility, inconsistent access to in-person therapy, and fluctuating symptoms. As digital health continues to evolve, music therapy apps can improve motor function, cognition, and emotional well-being in PD patients in a home based, user friendly format. To assist individuals facing neurological disorders, apps such as MusiCure and SingFit provide evidence-based approaches to advancing speech, emotional regulation, and motor coordination. Research evaluating digital music interventions indicates that app based RAS can support gait coordination, improve hand dexterity, and enhance speech fluency by employing entrainment, neuroplasticity and auditory-motor coupling.

Artificial intelligence (AI) and machine learning (ML) algorithms can also analyze user data like symptom ratings, gait characteristics, movement patterns, emotional responses or listening history to tailor music-based interventions. For example, an algorithm may increase

rhythmic tempo when gait speech improves or recommend calming frequencies when stress levels are elevated. When paired with wearable sensors (accelerometers, gyroscopes, heart-rate monitors), AI can generate individualized insights and also support the early detection of changes in symptom patterns. This allows the app to adapt therapy intensity based on the use, adjust musical elements or notify users when their performance might deviate from baselines. By storing progress data, activity logs, and user feedback, therapists and clinicians can access summaries of gait consistency, adherence to therapy sessions or changes in cognitive function, enabling more informed clinical decision making and effective communication in healthcare.

Motor symptoms such as tremor, bradykinesia and rigidity can make touch navigation difficult for older adults. Cognitive symptoms like slowed processing speech and reduced working memory can complicate interaction with complex digital interfaces. To ensure proper and efficient usability, music therapy apps should follow established accessibility frameworks such as the Web Content Accessibility Guidelines (WCAG 2.2), ISO 9241-210 (Human-Centered Design) and age friendly design principles. These guidelines emphasize simplified navigation, consistent layouts, high contrast visuals, large touch targets (minimum of 9-10 mm), adjustable font sizes, error-tolerant interactions, and redundant modes of communication (visual, auditory, and tactile). Features such as voice-assisted navigation, offline caching of playlists, reduced menu depth, and auto adjusting brightness can further improve the user experience and reduce cognitive load. As technology becomes increasingly common and generalized, AI-driven insights with neurologically informed musical interventions can offer an increasingly effective tool for long term PD management.

Gaps in Existing Research

Though existing research supports the effectiveness of music therapy and mobile health (mHealth) interventions for PD, much of the current literature focuses on broad PD populations without considering how demographic factors may influence the effectiveness of music-based interventions. In response to gender specific differences, although data show that men and women frequently experience distinct symptoms like variations in motor severity, emotional burden, and quality of life outcomes, few studies analyze how music therapy may benefit these groups differently. While research has demonstrated that women may

show greater improvements in emotion processing and quality of life after certain PD treatments, men may experience more pronounced motor symptom changes, including improvements in conditions like camptocormia (Crispino et al., 2020; Maccarrone et al., 2024). More studies are needed to determine whether rhythmic cuing, therapeutic singing, or personalized music interventions yield distinct outcomes across gender groups. Moreover, many mHealth interventions assume users have high familiarity with smartphones, strong fine motor control and the ability to navigate complex menus. However, older adults with PD experience tremors, rigidity, bradykinesia, slowed processing speed, and cognitive decline which can make these interfaces hard to use.
Despite these challenges, few studies apply established guidelines for accessibility. Without these UI/UX designs in evidence based guidelines, many existing mHealth tools risk excluding populations that they aim to support. The same musical techniques can also produce different emotional and motor effects across individuals, making it difficult to standardize digital interventions across a large population. More research is needed to determine whether personalized playlists, frequency specific tones, or rhythm based training protocols yield consistent benefits across diverse PD populations.

The Need for a Region-Specific Music Therapy App for PD in Cincinnati

While research supports the effectiveness of app-based music therapy, there is very limited data on its influence among older men with Parkinson's Disease living in specific regions, such as Cincinnati, Ohio, due to its demographic characteristics, environmental history and patterns of PD prevalence among older men. Cincinnati was historically part of the American Rust Belt where decades of industrial activity contributed to long-term exposure to pollutants like particulate matter (PM2.5), nitrogen dioxide, and ground-level ozone. While the region has seen improvements in recent years, Cincinnati's location and history continues to influence current air quality patterns today. Epidemiological research has shown associations between long term exposure to certain pollutants and increased risk of neurological disorders, including PD. Though pollution itself is not a confirmed causal factor, studies look at the fact that chronic exposure to combustion byproducts and fine particulates may contribute to oxidative stress and neuroinflammation. Therefore, individuals living in

Cincinnati, Ohio, may face environmental risk factors associated with age and gender based vulnerability.

In Cincinnati and surrounding areas, PD prevalence is much higher among older men, aligning with national trends that show men have a 1.5 times greater risk of developing PD than women. Several factors may contribute to this, including differences in occupational exposure in work life, hormone related neuroprotection, and historical patterns of employment in industrial or labor intensive jobs. Additionally, Cincinnati's workforce involved manufacturing, shipping, and industrial labor, fields occupied by mostly men. Many older male individuals may have experienced decades of exposure to environmental conditions associated with toxin inhaling, heavy metals, or repetitive physical strain.

A mobile app targeting the Cincinnati, Ohio region addresses disparities in access to consistent therapeutic services. Its geography is characterized by hills, valleys, and dispersed suburban neighborhoods which can make frequent travel to clinics or therapy sessions challenging for older adults with mobility limitations. Public transportation is limited in certain areas and snowy/rainy weather conditions can restrict safe travel for individuals with gait instability. A music therapy app that provides rhythmic training and mood support from home could fill gaps in local service accessibility and reduce barriers to continuous treatment.

Methodology

This study evaluates the potential benefits of music therapy in enhancing the quality of life and cognitive functions of older men 60-80 years living in Cincinnati, Ohio diagnosed with Parkinson's Disease (PD). This methodology outlines how future research could collect data, gather participants, and evaluate the usability and feasibility of the proposed music therapy application.

Study Design and Population

The research will follow a mixed-methods approach, pre-intervention design, combining quantitative and qualitative data collection techniques to inform the development of the music therapy app. The target population consists of men aged 60-80 diagnosed with mild-moderate Parkinson's Disease, defined using established diagnostic requirements. These requirements will come from Hoehn & Yahr Stages II-III and UPDRS (Unified Parkinson's Disease Rating Scale) motor scores which will ensure consistent classification of PD severity across participants.

Inclusion Criteria:

- Males aged 60 or older
- Diagnosed mild-moderate PD (Hoehn & Yahr II-III and UPDRS)
- Able to use a smartphone or tablet with minimal assistance
- Cognitive capacity to provide informed consent (MoCA > 21)

Exclusion Criteria:

- Severe cognitive impairment preventing app use
- Advanced PD (Hoehn & Yahr IV-V)
- Hearing impairments making auditory therapy ineffective
- Comorbid neurological disorders affecting motor function (stroke or ALS)

Data Collection Methods

Analysis of Public Datasets (Months 1–3)

To establish a foundation for the intervention, publicly available datasets on music therapy for Parkinson's disease will be analyzed. Sources may include clinical trial results, patient-reported outcomes, and datasets from institutions such as the National Institutes of Health (NIH) and the Parkinson's Foundation. We will also include the Parkinson's Progression Markers Initiative (PPMI) database which includes longitudinal clinical data from more than 4,000 individuals with PD, including Unified Parkinson's Disease Rating Scale (UPDRS) motor scores, gait assessments, cognitive testing results and variables related to the demography of the populations (Marek et al., 2018). The data analysis will focus on effects of rhythmic interventions on gait and movement coordination, optimal therapeutic music features (tempo range, rhythmic regularity), limitations of non-digital music therapy delivery, and gaps in accessibility for older adults.

Expert Consultation (Months 2–5)

Neurologists and music therapists will be consulted to refine the music selection process and therapy modules. Their expertise will help identify how different musical elements (such as rhythm, tempo, and pitch) affect PD symptoms. Consultations will provide insights into integrating AI-driven personalization and sensor-based monitoring for real-time symptom tracking. A team of experts will be involved, including three (3) board-certified music therapists (MT-BC) in the USA, three (3) neurologists with medical degrees specializing in neurology, and two (2) neurosurgeons with

advanced training in neurosurgery and the nervous system. Semi-structured interviews with these experts will examine best practices for RAS, music-based interventions for gait, mood, and cognition, symptoms most responsive to auditory cueing, feasibility to integrating gait/tremor sensors, and considerations for older adult UI/UX design. Responses will be qualitatively analyzed to identify common themes that inform therapy module design and application usability.

Music Therapy Design and App Development (Months 6–12 months)

The proposed mobile application will integrate key components designed to support personalized music therapy digitally:

- Symptom Assessment Module for symptom severity
- AI/ML Algorithm Personalization for analyzing user movement data, symptom reports, and listening preference
- Smartphone sensors and wearable devices: Track step timing, tremor amplitude, and movement patterns
- UI/UX (User Interface) Optimization: Customizable offline playlists will be included for added convenience. We also included easy-to-read words, personalization based on mood/emotion, and emojis for visual imagery. For individuals concerned of strain to their eyes, we customized a light display option (Figure 1) and a dark display option (Figure 1). Some other special elements involve a welcome banner, mood & progress tracker, quick start button, reminders, and personalized music therapy sessions. These designs will follow WCAG 2.2 contrast and font guidelines, ISO 9241-210 human centered design, age-friendly usability standards through AARP/CDC.

Figure 3 displays the workflow of the proposed music therapy app.

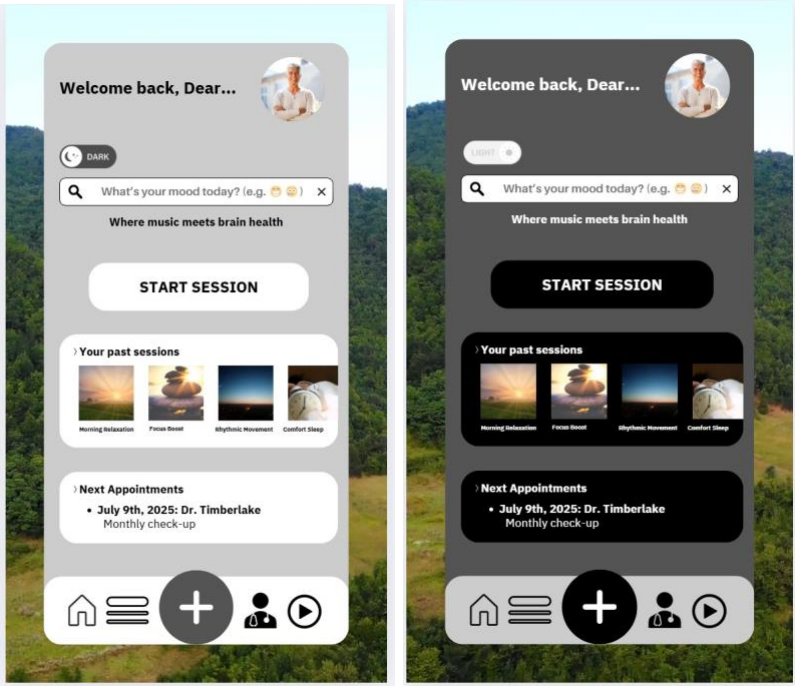

FIGURE 1. The light UI and dark UI design of the home screen of the music therapy app.

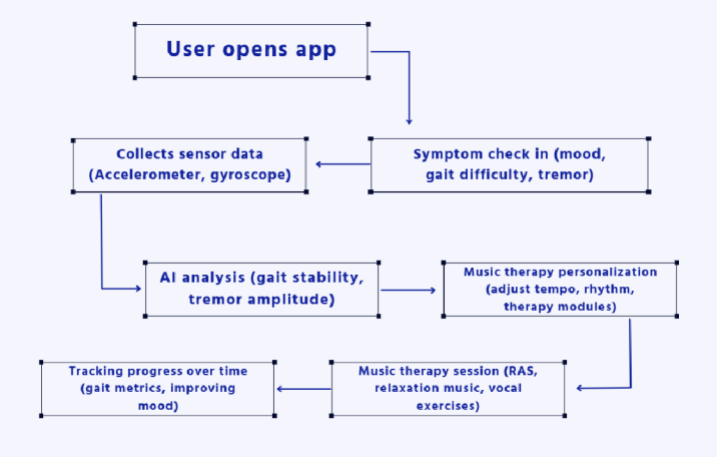

FIGURE 3. The system will collect user symptoms and sensor data which are then analyzed using machine learning algorithms to personalize RAS therapy sessions. Then, the app will change music tempo, frequency and therapy modules based on gait performance, tremor patterns and mood tracking and record this for future reference.

Testing and Evaluation (Months 13–16)

Future pilot testing will assess the usability, accessibility, technical performance and feasibility of the proposed music therapy app. A small

beta cohort of about 10-20 participants may be recruited through local Parkinson's support groups and neurology clinics in the Cincinnati area. Participants would complete guided tasks like launching therapy sessions, adjusting settings, and navigating application features. Usability will be evaluated using:

- System Usability Scale (SUS): Questionnaires that evaluate perceived usability, clarity, and ease of use.
- Task completion metrics: Measurements including time to complete each task, number of taps required, and number of errors (accidental taps from tremor, misselections).
- Observational analysis using think aloud protocols: Participants will be encouraged to verbalize their thought processes while researchers observe cognitive overload, difficulty understanding icons, hesitation, or confusion about sequence order during app use.
- Pre/post session physiological indicators (if sensor integration is active): Will test accuracy of step detection, reliability of tremor amplitude classification, responsiveness of tempo adjustments, and error margins relative to manual observation.

Final Refinement and Public Release (Months 17–18)

Following testing, an outreach/feedback strategy will be developed to promote its use. Improvements may include adjusted rhythmic patterns based gait sensor data, alternative input modes (voice first or gesture based navigation), offline caching, and frequency based therapy modules.

Ethical Considerations

To ensure participant safety and compliance with ethical standards, the following measures will be implemented. Participants would be required to provide informed consent before participating in usability testing or clinical evaluations. All participant data including symptom reports, movement measurements and usability responses would be securely stored and anonymized to protect privacy. It will also follow relevant digital health data protection standards to ensure responsible handling of personal health information. Because the target population is older adults with PD, additional care has to be taken to ensure participants fully understand the study and that participation doesn't cause physical or emotional discomfort.

Limitations

Despite its potential impact, the study presents several challenges. First, the proposed intervention has not yet undergone clinical testing and the conclusions here are based mainly on existing literature and conceptual design analysis. Second, in future testing, the study can experience participant dropout, sensor integration challenges with participant willingness, variability in music therapy response and technological barriers that individuals may struggle with.

Evidence from Existing Studies for App Development

Because this study is a design and literature-based review, no original clinical data were collected. This section synthesizes findings from previously published research to inform the development of the proposed mobile music therapy app. As of now, there is no specific study focusing on the use of music therapy to treat Parkinson's Disease in older men residing in Cincinnati, Ohio. However, existing research on music therapy and digital interventions for PD provides valuable insights and can be further utilized for the overall development of the music therapy app. A growing body of literature demonstrates that music therapy can improve both motor and non-motor symptoms of PD. Rhythmic auditory stimulation (RAS) is one of the most widely studied techniques and uses external rhythmic cues to synchronize movement and compensate for impaired internal timing caused by the basal ganglia dysfunctioning. Clinical studies have shown that RAS-based interventions can significantly improve gait velocity, stride length, and overall movement coordination in PD individuals (Thaut et al., 1996; Hellman et al., 2019). These improvements primarily are caused by rhythmic cues allowing patients to connect their movements to consistent auditory patterns, enabling the motor system to rely on other alternatives for neural pathways involving the cerebellum and auditory motor regions. Music therapy inventions have also proven benefits for emotional well-being, communication and overall quality of life. Organized music therapy programs incorporating singing, rhythmic movement, breathing exercises, and group musical activities have been associated with improvements in emotional regulation, daily functioning, and social engagement among individuals with PD (Pacchetti et al., 2000; Machado Sotomayor et al., 2021). This suggests that music therapy supports both neurological and psychosocial aspects of PD management. Recent research has additionally investigated the feasibility of introducing music therapy to individuals to

digital platforms which may address accessibility concerns in PD individuals with limitations in their movement or inconsistent access to face to face in-person therapy. For example, virtual group music therapy programs have shown high adherence rates and improvements in apathy and mood among participants with PD, indicating that remote music therapy interventions can provide meaningful psychological and emotional benefits (Shah-Zamora et al., 2024). Furthermore, systematic reviews and meta-analyses of neurologic music therapy interventions report significant improvements in gait velocity and stride length across multiple randomized controlled trials, further supporting the therapeutic value of music-based rehabilitation approaches (Li et al., 2025). These findings overall show that music therapy inventions, specifically those incorporating rhythmic auditory stimulation and through digital platforms can provide meaningful improvements in motor function, emotional well-being and quality of life for individuals with PD. This evidence informed the design of the proposed music therapy app by guiding the decisions on rhythmic cueing strategies, therapy session structures and accessibility features designed specifically for older adults with PD.

Study	Sample Size/Study Type	Intervention	Key Findings
Thaut et al. (1996)	Clinical Trial	Rhythmic Auditory Stimulation (RAS)	Improved gait velocity and stride patterns in PD patients
Pacchetti et al. (2000)	Experimental vs. Control Group	Structured music therapy (singing, rhythmic movement)	Improved emotional well-being, motor function, and quality of life
Hellman et al. (2019)	14 PD participants	Variable auditory cueing	Demonstrated improvements in gait performance
Machado Sotomayor et al. (2021)	Systematic Review	Multiple music therapy interventions together	Improvements in motor, emotional, and social outcomes
Shah-Zamora et al. (2024)	Virtual Therapy Program	Online group music therapy	Improved apathy, mood, and therapy adherence
Li et al. (2025)	Meta-analysis of RCTs	Neurological music therapy	Significant improvements in gait velocity and stride length

TABLE 1. Summary of Studies on Music Therapy Interventions in PD.

Discussion

Occupational patterns historically associated with older men including blue collar and agricultural work are linked to increased incidence of PD due to chronic exposure to environmental toxicants and higher rates of head injury (Wooten et al., 2004), explaining why older men in regions with strong industrial or agricultural histories like Cincinnati may face higher risk of PD. Music therapy arises from the literature as a promising complementary intervention for motor and non motor symptoms associated with PD. Because PD results from degeneration of dopaminergic neurons in the substantia nigra pars compacta, therapeutic methods that use auditory cueing, rhythmic structure, and emotional engagement may help compensate for impaired motor timing networks. Numerous studies show that music therapy can improve gait regulation, reduce freezing episodes, enhance mood and stimulate cognitive engagement. Although digital interventions are not a substitute for pharmacological treatment or regular exercise, they may enhance accessibility, personalization, and continuity of care for older adults who may face limited mobility and reduced access to specialized services. The results also highlight Rhythmic Auditory Stimulation (RAS) as a motor rehabilitation method, using structured auditory cues, like metronomes or rhythmically consistent music to support movement timing despite basal ganglia impairment. These cues allow individuals synchronize their movement with external rhythms, producing improvements in stride length, walking speed, and gait stability. Because rhythmic cues can also promote neuroplasticity by reinforcing alternative motor pathways, integrating RAS modules that can be customizable to the user would be highly effective and recommended. Based on prior research, treadmill based gait training paired with RAS may enhance motor performance even further. Thus, the app will incorporate an adjustable rhythm based treadmill guide and a library of tempo specific musical tracks to support motor function. The proposed app also integrates AI algorithms, allowing therapy sessions to adapt to individual symptom patterns. By analyzing user-generated data like movement patterns, gait characteristics and self reported mood, the system can automatically adjust tempos, recommend specific music tracks, or highlight specific exercises. Additionally, telemedicine integration can enable therapists to review progress reports, observe user engagement, and provide asynchronous recommendations, reducing the need for frequent in person visits.

Future research should evaluate the effectiveness of the music therapy app through controlled intervention studies. Pilot trials can gather

participants with mild-to-moderate PD and measure motor outcomes like gait velocity, stride length and freezing-of-gait frequency before and after app use. Wearable sensors and smartphone accelerometers could collect objective movement data while validated clinical scales like the UPDRS can look at symptoms progressing and how quality of life is altered.

Conclusion

Existing research strongly supports the potential of music therapy as a complementary intervention for managing both motor and non motor symptoms of Parkinson's Disease. While no current studies focus specifically on older men in Cincinnati, Ohio, the evidence demonstrates that rhythmic auditory stimulation, therapeutic singing, and other structured music-based activities can improve gait regulation, balance, emotional well being, respiratory function, and cognitive engagement in PD individuals. Given that older men experience higher PD prevalence from biological, occupational, and environmental factors, this particular population may benefit from accessible and individualized therapeutic options. Digital music therapy tools can provide continuous home-based support while reducing mobility and transportation barriers. The app aims to combine several evidence-based components like customizable rhythmic exercises, cognitive engagement activities, progress tracking, and AI driven personalization. Although future empirical testing is needed to validate the app's true effectiveness, the findings from existing research provide a strong foundation for developing a user centered music therapy app to benefit those with PD. This approach has the ultimate potential to support motor function, improve emotional well being, reduce isolation, and promote overall quality of life for older men with PD. By addressing accessibility challenges and observing the known neurological benefits of music, the proposed intervention may become an effective and valuable addition to PD management in Cincinnati and similar communities in the future.

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