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Effectiveness of Music Therapy in Improving Upper Limb Motor Function of Patients with Chronic Stroke

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Abstract

Music-supported therapy (MST) has emerged as an innovative approach in physical therapy, particularly in the rehabilitation of stroke patients who experience limitations in upper limb movement. Stroke remains one of the leading causes of long-term motor impairment, underscoring the importance of effective therapeutic interventions. The Wolf Motor Function Test (WMFT) serves as a standardized assessment tool for evaluating upper limb motor performance among individuals recovering from stroke. This study aimed to determine the effectiveness of MST using a tambourine in enhancing upper limb motor function among patients with chronic stroke, compared to the conventional physical therapy approach. Three participants from the City Health Office–Biñan underwent six treatment sessions each. Assessments were conducted before and after both the standard therapy and MST interventions using the WMFT. Results indicated improvements in upper limb motor function across both treatment types. However, statistical analysis using the Wilcoxon signed-rank test revealed that these improvements were not significant. Despite the absence of statistically significant findings, the integration of rhythmic, music-based activities—specifically those involving the tambourine—appeared to increase patient engagement and motivation during therapy. The researchers concluded that continuous participation in MST may contribute to functional enhancement in upper limb movement among chronic stroke patients.

Keywords: Music-supported Therapy; Chronic Stroke; Wolf Motor Function Test; Physical Therapy; Tambourine

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Introduction

Stroke, or cerebrovascular accident (CVA), occurs when blood flow to the brain is disrupted, leading to potential brain damage, disability, or death. It can cause sensorimotor impairments, cognitive deficits, and speech difficulties, often manifesting as weakness or paralysis on one side of the body. The chronic phase of stroke begins six months after the initial incident, during which individuals often experience ongoing impairments in upper limb function, including reduced muscle strength, dexterity, stability, and coordination, though tactile sensitivity and two-line discrimination may remain intact. Globally, stroke remains a major health concern. According to the World Stroke Organization (2022), it ranks as the second leading cause of death and the third leading cause of combined death and disability worldwide. Among its types, ischemic stroke—caused by an obstruction in blood flow—is the most common, compared to hemorrhagic strokes, which result from bleeding in the brain. Traditional rehabilitation methods for post-stroke upper limb recovery include constraint-induced movement therapy (CIMT), mirror therapy (MT), and motor imagery (MI). These methods focus on stimulating movement in the affected limb through various strategies—restricting the unaffected limb, using mirrored visual feedback, or engaging mental rehearsal of movements. Advanced methods such as virtual reality (VR) and brain-computer interfaces (BCI) have also emerged, using technology to enhance patient engagement and help retrain neural pathways for improved coordination and strength. In addition to these standard approaches, music-supported therapy (MST) is an emerging intervention that uses musical activity—such as playing instruments—to enhance motor recovery in stroke patients. This method leverages rhythmic repetition, audio-motor integration, and the motivational power of music to facilitate brain reorganization and improve function. Research, including recent studies on enriched Music-Supported Therapy (eMST), suggests that MST can improve upper limb performance and quality of life more effectively than traditional therapies. The current study aims to further investigate the benefits of combining music therapy—specifically using a tambourine and popular music—with conventional treatment to make rehabilitation more engaging and effective for chronic stroke patients.

Methodology

The study focused on patients with left-sided chronic ischemic strokes who exhibited right upper limb hemiparesis. The left hemisphere of the brain, responsible for analytic and symbolic processing, is commonly affected in such cases, leading to deficits in rhythm and melody discrimination. However, the right hemisphere, which governs holistic and musical abilities as well as visuospatial functions, remains intact. This makes individuals with left hemisphere damage suitable for music-based interventions, as they can better engage in and benefit from activities involving rhythm and musical perception. Thus, the study population specifically targeted these patients to evaluate the effectiveness of music-supported therapy (MST) in enhancing upper limb motor function. A sample of three participants was selected through purposive sampling from the City Health Office 1 CBR - PT Department in Biñan, Laguna. The inclusion criteria required patients aged 40 to 75 years old with left-sided chronic ischemic stroke (6 months to 1-year post-onset) and grades 0–2 on the Modified Ashworth Scale, who were already receiving physical therapy. The exclusion criteria eliminated those with cognitive, emotional, or sensory impairments, various forms of aphasia or apraxia, proprioceptive or visual deficits, hearing issues, chronic strokes exceeding one year, or more severe spasticity (grades 3–4 on the scale). These strict criteria ensured that the participants had the cognitive and physical ability to take part effectively in music therapy. The sampling technique was purposive, a method that deliberately selects participants based on specific characteristics relevant to the research objectives. This approach, as defined by the APA Dictionary of Psychology (2018), allowed the researchers to ensure the participants were ideal representatives of the target population. The primary data were collected using scores from the Wolf Motor Function Test (WMFT), comparing pre-test and post-test results, while secondary datawere obtained from previous literature and research studies on the effectiveness of music therapy in post-stroke rehabilitation. The instrument used, the WMFT, is a 17-item quantitative assessment tool measuring motor performance in the upper limb of chronic stroke patients. It includes 15 functional and 2 strength-based tasks, scoring performance on a 6-point scale from 0 (“does not attempt”) to 5 (“movement appears normal”). Higher scores signify better functional capability. The test was administered to both the music and standard conditions before and after intervention. The music phase involved playing a tambourine to music, while the standard condition consisted of traditional physical therapy alone. The WMFT has been validated in previous research, demonstrating high reliability (r = 0.90–0.95, ICC = 0.97) and adequate concurrent validity with the Upper Extremity Fugl-Meyer Assessment. The data gathering procedure comprised three phases: pre-implementation, implementation, and post-implementation. During the pre-implementation phase, the research proposal received institutional approval, followed by recruitment of participants and obtaining informed consent. Participants also completed a demographic questionnaire. In the implementation phase, baseline (pre-test) WMFT scores were collected before the intervention. Over a 10-week period, participants attended 1–2 sessions per week. During the music condition, they performed traditional physical therapy exercises—such as range of motion (ROM) and proprioceptive neuromuscular facilitation (PNF) techniques—combined with a 5-minute music therapy session using a tambourine to play *Macarena* by Los del Rio. This activity synchronized upper limb movement with the beat of the song, integrating PNF patterns into rhythmic motor training. After a two-week rest period, participants repeated the same schedule but received only conventional therapy (the standard condition). Post-test WMFT scores were then collected. In the post-implementation phase, the researchers performed statistical analysis using the Wilcoxon Signed Rank Test to compare the pre-test and post-test results from both conditions. The analysis aimed to determine whether music therapy led to significant improvements in motor function compared to standard physical therapy alone. Results were then analyzed to assess the practical and clinical significance of the findings, contributing to a deeper understanding of how music-supported therapy may enhance motor recovery in chronic stroke patients.

Results

This chapter presents the experimental findings, which has a detailed discussion of the analysis conducted on the music therapy in improving the upper limb motor function of the patients with chronic stroke. These tables encapsulate the difference of the standard approach of therapy to the music induced therapy using the WMFT.

Table 1 presents the demographics of the patients that had participated in this study, which includes their age, sex, handedness, and their time of stroke. All patients are male and right-handed. The age ranges from 43-72 years and time since stroke ranges from 6-8 months which accurately fit the inclusion criteria. This indicates that the patients are part of the typical population affected by stroke.

Table 2 presents the pre-test scores of WMFT, FAS, and grip strength under the music condition. The results showed that participants had a mean WMFT time of M = 61.19 seconds (SD = 25.57), indicating relatively slow task performance at baseline. In terms of functional ability, the group obtained a mean FAS score of

Table 1: Demographics of Participants in this study.

Patient	Age	Sex	Handedness	Time Since Stroke
Patient 1	43	M	Right	8 months
Patient 2	72	M	Right	6 months
Patient 3	54	M	Right	7 months

Table 2: Pre-test Scores of WMFT, FAS, and Grip Strength under the Music Condition.

Measure	Average	SD	Min	Max
WMFT Time (seconds)	61.19	25.57	40.27	89.70
FAS	45.00	4.36	40.00	48.00
Grip Strength Pre (kg)	7.91	6.98	3.50	15.96

Table 3: Post-test Scores of WMFT, FAS, and Grip Strength under the Music Condition.

Measure	Average	SD	Min	Max
WMFT Time (seconds)	54.63	36.40	29.69	96.40
FAS	59.00	9.54	53.00	70.00
Grip Strength Pre (kg)	10.10	5.72	5.08	16.33

Table 4: Post- test Scores of WMFT, FAS, and Grip Strength under the Standard Condition.

Measure	Average	SD	Min	Max
WMFT Time (seconds)	48.07	28.22	28.39	80.40
FAS	68.67	1.53	67.00	70.00
Grip Strength Pre (kg)	10.22	55.52	5.26	16.24

M = 45.00 (SD = 4.36), suggesting a moderate level of upper limb function prior to the intervention. Additionally, the mean grip strength was M = 7.91 kg (SD = 6.98), reflecting generally low hand strength among participants. Overall, these findings indicate that participants under the music condition started with limited motor performance, providing a baseline for evaluating the effects of the intervention.

Table 3 presents the post-test scores of WMFT, FAS, and grip strength under the music condition. The results showed a mean WMFT time of M = 54.63 seconds (SD = 36.40), indicating improved task performance compared to baseline. The mean FAS score increased to M = 59.00 (SD = 9.54), suggesting enhanced upper limb functional ability following the intervention. Additionally, the mean grip strength improved to M = 10.10 kg (SD = 5.72), reflecting gains in hand strength among participants. Overall, these findings indicate that participants demonstrated improvements in motor performance after exposure to the music condition.

Table 4 presents the post-test scores of WMFT, FAS, and grip strength under the standard condition. The results showed a mean WMFT time of M = 48.07 seconds (SD = 28.22), indicating improved task performance compared to baseline. The mean FAS score increased to M = 68.67 (SD = 1.53), suggesting enhanced upper limb functional ability after the intervention period. Additionally, the mean grip strength improved to M = 10.22 kg (SD = 5.57), reflecting gains in hand strength among participants. Overall, these findings indicate that participants also demonstrated improvements in motor performance under the standard condition.

Table 5 presents the comparison of Wolf Motor Function Test (WMFT), FAS, and grip strength scores between the pretest and posttest under the music condition. The results of the Wilcoxon signed-rank test showed no statistically significant differences across all measures. Specifically, WMFT time decreased from M = 61.19 ± 25.57 to M = 54.63 ± 36.40 (Z = -1.069, p = 0.285), FAS increased from M = 45.00 ± 4.36 to M = 59.00 ± 9.54 (Z = -1.604, p = 0.109), and grip strength improved from M = 7.91 ± 6.98 to M = 10.10 ± 5.72 (Z = -1.604, p = 0.109). Despite the observed improvements in mean scores, these changes were not statistically significant. These findings suggest that, although there were positive trends in motor performance, the music condition did not result in significant improvements.

Table 6 presents the comparison of Wolf Motor Function Test (WMFT), FAS, and grip strength scores between the pretest and posttest under the standard condition. The results of the Wilcoxon signed-rank test showed no statistically significant differences across all measures. Specifically, WMFT time decreased from M = 55.15 ± 26.21 to M = 48.07 ± 28.22 (Z = -1.604, p = 0.109), FAS increased from M = 64.33 ± 5.13 to M = 68.66 ± 1.53 (Z = -1.342, p = 0.180), and grip strength improved from M = 8.23 ± 6.81 to M = 10.22 ± 5.57 (Z = -1.604, p = 0.109). Although the mean scores indicate improvements in motor performance, these changes were not statistically significant. These findings suggest that the standard condition did not demonstrate significant improvements in upper limb motor function over time.

Table 7 presents the comparison of pretest WMFT time, FAS, and grip strength between the music and standard conditions using the Wilcoxon signed-rank test. The results showed no statistically significant differences across all measures. Specifically, WMFT

Table 5: Comparison of Wolf Motor Function Test Between Pretest and Posttest under the Music Condition.

Movement	Pairs	Mean ± SD	Statistic (Wilcoxon)	p-value	Decision	Conclusion
WMFT Time	Pretest	61.19 ± 25.57	-1.069	0.285	Accept Null	NOT Significant
	Posttest	54.63 ± 36.40				
FAS	Pretest	45 ± 4.36	-1.604	0.109	Accept Null	NOT Significant
	Posttest	59 ± 9.54				
Grip Strength	Pretest	7.91 ± 6.98	-1.604	0.109	Accept Null	NOT Significant

Table 6: Comparison of Wolf Motor Function Test Between Pretest and Posttest under the Standard Condition.

Movement	Pairs	Mean ± SD	Statistic (Wilcoxon)	p-value	Decision	Conclusion
WMFT Time	Pretest	55.15 ± 26.21	-1.604	0.109	Accept Null	NOT Significant
	Posttest	48.07 ± 28.22				
FAS	Pretest	64.33 ± 5.13	-1.342	0.180	Accept Null	NOT Significant
	Posttest	68.66 ± 1.53				
Grip Strength	Pretest	8.23 ± 6.81	-1.604	0.109	Accept Null	NOT Significant
	Posttest	10.22 ± 5.57				

Table 7: Comparison of Pretest WMFT Time Between the Music and Standard Conditions.

Movement	Groups	Mean ± SD	Statistic (Wilcoxon)	p-value	Decision	Conclusion
WMFT Time	Music	61.19 ± 25.57	-1.604	0.109	Accept Null	NOT Significant
	Standard	55.15 ± 26.21				
FAS	Music	45 ± 4.36	-1.604	0.109	Accept Null	NOT Significant
	Standard	64.33 ± 5.13				
Grip Strength	Music	7.91 ± 6.98	-1.604	0.109	Accept Null	NOT Significant
	Standard	8.23 ± 6.81				

Table 8: Comparison of Posttest WMFT Time Between the Music and Standard Conditions.

Movement	Groups	Mean ± SD	Statistic (Wilcoxon)	p-value	Decision	Conclusion
WMFT Time	Music	54.63 ± 36.40	-1.604	0.109	Accept Null	NOT Significant
	Standard	48.07 ± 28.22				
FAS	Music	59 ± 9.54	-1.342	0.180	Accept Null	NOT Significant
	Standard	68.66 ± 1.53				
Grip Strength	Music	10.10 ± 5.72	-1.069	0.285	Accept Null	NOT Significant
	Standard	10.22 ± 5.57				

Table 9: Comparison Between the Pretest Music and Posttest Standard Conditions.

Movement	Groups	Mean ± SD	Statistic (Wilcoxon)	p-value	Decision	Conclusion
WMFT Time	Pretest Music	61.19 ± 25.57	-1.604	0.109	Accept Null	NOT Significant
	Posttest Standard	48.07 ± 28.22				
FAS	Pretest Music	45 ± 4.36	-1.633	0.102	Accept Null	NOT Significant
	Posttest Standard	68.66 ± 1.53				
Grip Strength	Pretest Music	7.91 ± 6.98	-1.604	0.109	Accept Null	NOT Significant
	Posttest Standard	10.22 ± 5.57				

time under the music condition (M = 61.19 ± 25.57) and standard condition (M = 55.15 ± 26.21) did not significantly differ (Z = -1.604, p = 0.109). Similarly, FAS scores (Z = -1.604, p = 0.109) and grip strength (Z = -1.604, p = 0.109) also showed no significant differences between conditions. These findings indicate that participants had comparable baseline motor performance under both conditions prior to the intervention.

Table 8 presents the comparison of posttest WMFT time, FAS, and grip strength between the music and standard conditions using the Wilcoxon signed-rank test. The results showed no statistically significant differences across all measures. Specifically, WMFT time under the music condition (M = 54.63 ± 36.40) and standard condition (M = 48.07 ± 28.22) did not significantly differ (Z = -1.604, p = 0.109). Similarly, FAS scores (Z = -1.342, p = 0.180) and grip strength (Z = -1.069, p = 0.285) also showed no significant differences between conditions. These findings indicate that there were no significant differences in upper limb motor function between the music and standard conditions after the intervention.

Table 9 presents the comparison between the pretest scores under the music condition and the posttest scores under the standard condition using the Wilcoxon signed-rank test. The results showed no statistically significant differences across all measures. Specifically, WMFT time under the pretest music condition (M = 61.19 ± 25.57) and posttest standard condition (M = 48.07 ± 28.22) did not significantly differ (Z = -1.604, p = 0.109). Similarly, FAS scores (Z = -1.633, p = 0.102) and grip strength (Z = -1.604, p = 0.109) also showed no significant differences between conditions. These findings indicate that there were no significant differences in upper limb motor function between the pretest music and posttest standard conditions.

Discussion

This study investigated the efficacy of integrating music therapy into standard rehabilitation for chronic stroke patients, specifically targeting upper limb motor recovery. Progress was assessed via the Wolf Motor Function Test (WMFT), which evaluates task completion time, functional ability, and grip strength. Participants were a small, uniform group (all male, ages 43–72, right-handed, was over 6 months post-stroke). Results showed that both music therapy and standard treatment led to improvements from pretest to post test. However, statistical analysis found no significant difference in the outcomes ($p > 0.1$). The findings indicated no statistically significant improvement in upper limb motor function ($p > 0.1$). Both conditions demonstrated strong performance in functional ability (FAS) and grip strength, along with lower (better) WMFT times. However, the music condition showed slightly greater improvements in FAS and grip strength, while the standard condition achieved marginally better WMFT time results. Overall, both interventions were comparably effective, consistent with previous studies. Individually, the study yielded promising results. Improvements were observed in the pre- and post-test WMFT scores under the music condition, similar to those seen with the standard approach. However, the conventional approach demonstrated higher overall scores compared to the music-based condition. The researchers suggest that this difference may be attributed to the inconsistent patient attendance during the music-conditioned therapy sessions. Originally, the intervention was designed to run for three weeks with two sessions per week, but it was extended to four weeks to complete a total of six sessions. This suggests that the intervention may have been more effective with consistent adherence, allowing for better motor learning, reinforcement of neuromuscular adaptation, and continuous progress. Despite these challenges, patient autonomy in decision-making was respected, and their participation in the study was greatly valued and appreciated. The study concludes that while music therapy did not significantly outperform standard treatment, it still contributed to motor improvement and could be used alongside conventional therapy. Limitations such as small sample size and inconsistent attendance may have affected the results.

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