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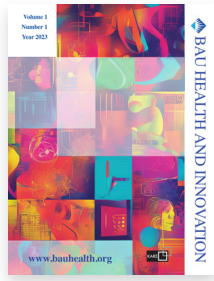

Original Article

Music Therapy in Acute Stroke

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Abstract

Objectives: This study aims to explore the potential benefits of adding music therapy to traditional treatment methods for post-acute stroke patients. The primary outcomes focused on were mood stabilization, recovery of cognitive skills and functions, and reduction of anxiety.

Methods: The research was carried out in the Neurology Department of Gebze Fatih State Hospital. A group of volunteer patients aged 18-80, diagnosed with acute stroke, participated. The participants were divided into a music therapy group and a control group, with 20 patients in each. They were hospitalized for approximately seven days. The music therapy group underwent a varied auditory regimen, including Turkish art, pop, and acoustic music, as well as foreign easy listening and classical music, for four hours daily. Assessments before discharge included the Beck tests for anxiety and depression, the MOCA for cognitive evaluation, and NIHSS score recordings at admission and discharge. The Modified Rankin Score was also recorded before discharge. Data analysis was performed using SPSS software (version 25).

Results: The comparative analysis showed no significant effect of music therapy on depression, anxiety, or MOCA test scores in acute stroke patients before discharge. Notably, lower Beck depression scores correlated with patients who had lower NIHSS scores at both admission and discharge (p=0.011 and p=0.007, respectively). Moreover, patients with minor strokes displayed significantly higher musically-evoked emotional responses (e.g., joy, sadness, motivation) compared to those with moderate strokes (p=0.011).

Conclusion: Acute stroke patients with lower NIHSS scores may benefit most from passive music therapy during their hospital stay. This highlights the subtle role of music therapy, suggesting its potential effectiveness might depend on the severity of the stroke.

Keywords: Music therapy, rehabilitation, stroke.

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In light of recent theoretical and practical developments, enrichment activities have increasingly been recognized for their role in facilitating the rehabilitation of post-stroke patients.[1] Among the myriad rehabilitative strategies available, music therapy stands out due to its marked effectiveness. Research has consistently shown that it can substantially aid post-stroke patients in regaining linguistic and motor capabilities.

A stroke occurs due to the blockage or rupture of arteries that supply essential nutrients and oxygen to the brain, leading to brain cell death.[2] This often results in profound disabilities. Due to the intricate specialization of the brain's regions, the after-effects of a stroke can range from basic difficulties in self-care to challenges in executing complex tasks.

Rehabilitation for stroke survivors requires a multifaceted approach, tailored to the specific brain region affected. Among these approaches, music therapy has been highlighted for its therapeutic potential.[3] By leveraging the principles of neuroplasticity, music therapy can mitigate symptoms such as pain, fatigue, and anxiety. It engages diverse brain regions involved in listening, memory, emotions, and more.[4,5]

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Two primary trends dominate music therapy: active and passive. Active music therapy involves patients directly in playing or creating music, while passive music therapy centers around listening.[6] Regardless of the approach, elements like rhythm, pace, and tempo are central to the therapy's efficacy.

With the human brain's capacity for neuroplasticity, music's engagement with various brain regions can offer a formidable therapeutic tool. It has the potential to activate the brain's reward circuits, facilitate synchronized neuronal firing, and even counteract the negative effects of noise on neuroplasticity.[7,8]

Materials and Methods

Our study was conducted at the Neurology Department of Fatih Gebze State Hospital, focusing on the therapeutic effects of passive music therapy on post-stroke patients. The study was approved for implementation in the facility following a decision by the Clinical Research Ethics Committee of University of Health Sciences Kocaeli Derince Training and Research Hospital.

Here is a detailed breakdown of our methodological approach:

Study Setting and Participants

The study was conducted within the neurology department. We recruited conscious and cooperative volunteers, both male and female, aged between 18 and 80. All participants were diagnosed with acute stroke, and their typical hospital stay was approximately seven days. The study included a total of 40 participants, with 20 assigned to the music therapy group and the remaining 20 to the control group.

Music Therapy Rationale

Participants in the music therapy group were exposed to four hours of diverse music daily for a month. The playlist ranged from Turkish art music to classical pieces, incorporating both familiar and unfamiliar songs. This approach was designed to stimulate various brain regions, with the aim of potentially aiding the recovery process.

Patient Selection

The study primarily focused on patients with subacute ischemic strokes. Participants were evaluated at both the onset and conclusion of the music therapy sessions. To ensure unbiased patient selection, we employed block randomization. The allocation of patients into either the music therapy or control group was determined by drawing lots.

Inclusion and Exclusion Criteria

Participants selected for this study were required to be conscious as determined by the Glasgow Coma Scale, diagnosed with ischemic stroke, and had to meet specific criteria on mental status and NIHSS assessments. We excluded those who were uncooperative, in a coma, had recently undergone surgery, or were dissatisfied with the therapy.

Research Protocol

Each participant in the music therapy group participated in four-hour music sessions daily. These sessions rotated among four diverse playlists, encompassing a variety of rhythms, beats per minute (BPM), and genres. The selections ranged from popular Turkish hits to renowned classical compositions.

Scales and Tests Employed

Beck Depression Inventory: This self-report inventory consists of 21 multiple-choice questions and is used to measure the severity of an individual's depression. The items address symptoms such as hopelessness, irritability, and feelings of guilt or of being punished.

Beck Anxiety Inventory: Similar in format to the Beck Depression Inventory, this 21-item scale measures the severity of an individual's anxiety. The items focus on common anxiety symptoms, including numbness, tingling, excessive sweating not due to heat, and fear of the worst happening.

Montreal Cognitive Assessment (MoCA): This assessment, which takes about 10 minutes, evaluates several cognitive domains. These include short-term memory, visuospatial abilities, executive functions, and attention. A score of 26 or above (out of 30) is considered normal.

Modified Rankin Scale: This scale is widely used in stroke research to measure disability. It assesses the degree to which daily activities can be performed without assistance, with the scale ranging from 0 (no symptoms) to 6 (death).

NIH Stroke Scale (NIHSS): This 11-item scale evaluates the impairment caused by a stroke. It assesses language use, attention, consciousness, visual field loss, extraocular movement, motor strength, ataxia, dysarthria, and sensory loss. Higher scores indicate more severe strokes.

Statistical Analysis

The statistical analysis in our study was conducted using SPSS (Statistical Package for the Social Sciences), version 25. SPSS is a data management and analysis tool developed by IBM, a multinational technology corporation based in Armonk, New York, USA.

Following data collection, we undertook comprehensive statistical analyses using SPSS. The t-test was employed to evaluate potential differences between the two groups

Table1. Logistic degression analysis for depression

	B	SE	Wald	Df	Sig.	Exp(B)	95% CI for EXP(B)	
							Lower	Upper
Minor	−19.510	9419.487	0.000	1	0.998	0.000	0.000	0.0001
NIH score before discharge	0.558	0.280	3.959	1	0.047	1.746	1.008	3.024
Dichotomized to 0−10 minimal to mild, >10 moderate	43.117	41281.976	0.000	1	0.999	53160099495 14301400.000	0.000	0.0002
Constant	−4.077	1.808	5.084	1	0.024	0.017		

B value: The slope of the line between the predictor variable and the dependent variable, SE: Standard error, Wald: Used to determine statistical significance for each of the independent variables, Df: The number of valid observations minus 1, Sig.: Significance level, Exp (B): The predicted change in odds for a unit increase in the predictor, 95% CI: A range of values that you can be 95% certain contains the true mean of the population, NIH: National Institutes of Health Stroke Score.

Table 2. Logistic regression analysis for anxiety

	B	SE	Wald 0	Df	Sig.	Exp(B)	95% CI for EXP(B)	
							Lower	Upper
Minor	37.473	10293.938	0.000	1	0.997	1880901923 5069932.000	0.000	0.0001
Dichotomized to 0-16 Minimal to Mild, >16 Moderate	38.088	10010.802	0.000	1	0.997	3479081771 2344268.000	0.000	0.0002
Constant	-57.588	11926.331	0.000	1	0.996	0.000		

in our study. We used the chi-square test to determine the presence of a relationship between our categorical variables. Additionally, Binary Logistic Regression was applied to assess depression and anxiety, aiming to understand the statistical significance of these conditions in relation to the variables used in our study.

Results

In this study, we meticulously collected and analyzed demographic data from a cohort of 40 patients who had suffered a stroke. The gender distribution included 23 males and 17 females. The age distribution was relatively similar between the control and music therapy groups, with average ages of 67.05 and 67.45 years, respectively.

Etiologically, all 40 patients in the cohort experienced symptoms of ischemic stroke. Regarding stroke severity, 24 patients were identified with moderate severity, while the remaining 16 fell into the minor stroke severity category. Notably, there were no cases of severe stroke within our study parameters.

A detailed examination of the musical preferences within the cohort showed a clear preference for Turkish Sanat Music and Classical Music, with mean enjoyment scores of 0.74 and 0.42, respectively. Turkish Pop Music followed with a mean score of 0.21, and Foreign Music had a mean score of 0.16.

Our analysis covered a range of variables, including age, duration of inpatient care, pre-music therapy NIH score, pre-discharge NIH score, Modified Rankin Scale scores, and psychological indices such as Beck depression and anxiety, and MOCA scores. When comparing the music therapy group with the control group, we found uniformity across most variables. However, a notable difference was observed in the depression scores: the control group had a mean depression score of 12, compared to a lower mean score of 9.75 in the music therapy (MT) group.

Observing the variation in depression scores between the cohorts, we conducted a detailed logistic regression analysis to uncover potential underlying factors. The analysis highlighted the NIH score recorded prior to patient discharge as a significant determinant of depression levels ($p<0.047$). The data suggests an inverse relationship, where increasing NIH scores, indicative of greater neurological disability, correspond to a higher likelihood of depression (Table 1).

We conducted a detailed logistic regression analysis to develop a model for anxiety. However, the analysis revealed that the variables included in our study did not significantly contribute to a discernible model for anxiety (Table 2).

Our analytical efforts extended to exploring potential correlations between overall satisfaction with music therapy and various relevant variables, including age, gender,

Table3. Correlation table between music therapy and variables used in the study

	n	Age	Gender	NIH score before music therapy	NIH score before discharge	Modified rankin scale	Beck depression test	Beck anxiety test
Music therapy overall satisfaction out of 10								
Pearson Correlation	0.171	−0.004	−0.157	−0.572	−0.597	−0.488	−0.653	−0.503
Sig. (2-tailed)	0.485	0.988	0.521	0.011	0.007	0.034	0.002	0.028
N	19	19	19	19	19	19	19	19

n: Number of patients, Sig (2-tailed): The two-tailed p-value evaluating the null against an alternative that the mean is not equal to 50, N value: The number of valid observations for the variable.

depression, anxiety, Modified Rankin Scale (MRS), and NIH score. The results indicated no statistically significant correlation between overall satisfaction with music therapy and both age ($p<0.998$) and gender ($p<0.521$) (Table 3).

In contrast, significant correlations were found in other areas. Notably, there were statistically significant correlations between overall satisfaction with music therapy and depression ($p<0.002$), anxiety ($p<0.028$), NIH score recorded prior to the initiation of music therapy ($p<0.011$), NIH score prior to discharge ($p<0.007$), and MRS ($p<0.034$). (Table 3).

Utilizing the Pearson Correlation coefficient, we deduced a relationship between NIH scores, MRS, and music enjoyment. As NIH scores and MRS–indicators of disability–decreased, there was a heightened propensity for patients to derive more enjoyment from the music. This trend paralleled the psychological metrics, suggesting that as depression and anxiety levels decreased, patients' enjoyment of music tended to increase (Table 3). Upon conducting thorough analysis, we found that gender did not significantly influence musical preferences. However, an important observation emerged: patients with milder symptoms showed increased engagement and appreciation for music. This indicates a potential correlation: as the severity of disability decreases, the enjoyment and appreciation of music seem to increase (Table 3).

In our study, we included four different genres of music: Turkish pop music, Turkish Sanat music, foreign music, and classical music. Our goal was to identify patients' preferences among these genres and to determine if any underlying factors influenced their musical tastes (Table 4).

Our findings also indicated that the presence or absence of depression appeared to affect the level of enjoyment derived from the music playlists. In the music therapy group, only one case of moderate anxiety was observed. Consequently, due to the limited range of anxiety levels represented in our cohort, it was not feasible to evaluate any potential relationship between the severity of anxiety and the impact of music on patient experience (Table 2).

In our ongoing efforts to understand the factors that influence the effectiveness of music therapy, we focused on examining the correlations between age, MOCA test results, and NIH scores in relation to the overall impact of music therapy. We paid special attention to the specificity of musical genres in this context (Table 5–8).

Our thorough analysis revealed that neither age nor the MOCA test results significantly influenced the overall effectiveness of music therapy on our patient cohort. However, the NIH score emerged as a significant factor. Notably, this effect was most pronounced with Turkish music (Table 5–8).

This finding suggests an important relationship: a lower NIH score, indicative of less severe neurological impairment, tends to enhance the therapeutic effects of music on the patient. This relationship was especially strong in the context of Turkish music, indicating a profound connection between the severity of neurological impairment and the therapeutic impact of this specific genre (Table 5).

Discussion

From a neurological perspective, music can be described as an organized form of sound that stimulates the brain at various levels–sensory, motor, cognitive, and emotional–activating neuronal pathways in a music-specific manner. Clinical research indicates that music can initiate processes in the brain that translate to therapeutic effects beyond music itself.

The basis for this phenomenon lies in the fact that the brain processes music through multiple areas simultaneously. When listening to music, it is not only the auditory regions that are activated but an entire network across the brain. This response to music is comprehensive but differentiated across brain regions.[9–12]

Music has been shown to influence stress hormones, anabolic hormones, mood, and the immune system. The act of listening to music triggers the release of dopamine, a neurotransmitter associated with pleasure, which is

Table 4. T test analysis for music therapy overall satisfaction

	Levene's test for Equality of Variances		t-test for equality of means						
	F	Sig.	T	Df	Sig. (2-tailed)	Mean difference	SE difference	95% CI of the difference	
								Lower	Upper
Total impact of Turkish Music									
EVA	1.747	0.204	1.273	17	0.220	3.917	3.076	−2.572	10.405
EVnA			1.338	14.643	0.201	3.917	2.927	−2.335	10.169
Total impact of Foreign Music									
EVA	0.695	0.416	0.266	17	0.793	0.655	2.459	−4.534	5.844
EVnA			0.280	14.621	0.784	0.655	2.342	−4.348	5.658
Total impact of Classical Music									
EVA	0.121	0.732	−0.536	17	0.599	−1.060	1.977	−5.231	3.112
EVnA			−0.544	13.249	0.596	−1.060	1.949	−5.262	3.143
Total impact of sanat Turkish Music									
EVA	0.439	0.517	0.063	17	0.950	0.167	2.645	−5.413	5.746
EVnA			0.065	14.189	0.949	0.167	2.546	−5.287	5.621
Did the patient prefer to listen to Turkish Music?									
EVA	1.272	0.275	0.527	17	0.605	0.107	0.203	−0.322	0.536
EVnA			0.554	14.638	0.588	0.107	0.194	−0.306	0.521
Did the patient prefer to listen to Foreign Music?									
EVA	0.069	0.796	0.130	17	0.898	0.024	0.183	−0.363	0.410
EVnA			0.131	13.006	0.898	0.024	0.182	−0.369	0.416
Did the patient prefer to listen to Classical Music?									
EVA	0.100	0.755	−2.099	17	0.051	−0.464	0.221	−0.931	0.002
EVnA			−2.055	11.892	0.063	−0.464	0.226	−0.957	0.029
Did the patient prefer to listen to Turkish Sanat Music?									
EVA	0.100	0.755	0.161	17	0.874	0.036	0.221	−0.431	0.502
EVnA			0.158	11.892	0.877	0.036	0.226	−0.457	0.529
Music Therapy overall satisfaction out of 10									
EVA	0.040	0.844	0.656	17	0.521	0.917	1.398	−2.033	3.866
EVnA			0.666	13.323	0.517	0.917	1.376	−2.048	3.881

F value: a value on the F distribution. Various statistical tests generate an F value. The value can be used to determine whether the test is statistically significant, T value: This is the Student t-statistic. It is the ratio of the difference between the sample mean and the given number to the standard error of the mean, EVA: Equal variance assumed, EVnA: Equal variance not assumed.

secreted in the striatum of the brain during rewarding experiences such as listening to music. Music serves not just as an art form but also as a form of medicine and meditation, beneficial to both body and soul. It plays a role in reducing levels of stress, anger, and anxiety.[12]

Additionally, research has demonstrated that music can evoke emotions, and that any damage to the brain structures responsible for emotional processing can lead to impaired emotional responses to music.[4]

Initially, our study aimed to evaluate and test the effects of music on the rehabilitation and recovery of post-stroke patients through two types of music therapy: active and passive. We initially planned for the therapy to span at least two months. However, due to the Covid-19 pandemic, we focused solely on passive music therapy and reduced both the duration of our study and the sample size of our patients.

We also intended to use music therapy as a complementary treatment alongside classical methods for hospitalized patients suffering from neurological diseases, to enhance the outcomes of standard treatment. Furthermore, music therapy was envisaged to improve patients' mood, motivation, and cognitive functions, such as memory and attention.

Challenging an injured brain with rehabilitative techniques can enhance its abilities. Music influences mood; different musical pieces evoke pleasant or unpleasant emotions,

Table 5. NIH discharge-age-MOCA correlation with Turkish Music

	Total Impact of Turkish Music	Age	NIH score before discharge	Moca: Overall score
Age				
Pearson correlation	–0.156	1	0.199	0.050
Sig. (2-tailed)	0.523		0.401	0.835
N	19	20	20	20
NIH score before discharge				
Pearson correlation	–0.474*	0.199	1	–0.295
Sig. (2-tailed)	0.040	0.401		0.206
N	19	20	20	20
Moca: Overall score				
Pearson correlation	0.202	0.050	–0.295	1
Sig. (2-tailed)	0.408	0.835	0.206	
N	19	20	20	20

Moca: Montreal Cognitive Assessment.

Table 6. NIH discharge-age-MOCA correlation with Foreign Music

	Age	NIH score before discharge	Moca: Overall score	Total Impact of Foreign Music
Age				
Pearson Correlation	1	0.199	0.050	–0.235
Sig. (2-tailed)		0.401	0.835	0.332
N	20	20	20	19
NIH score before discharge				
Pearson Correlation	0.199	1	–0.295	–0.417
Sig. (2-tailed)	0.401		0.206	0.076
N	20	20	20	19
Moca: Overall score				
Pearson Correlation	0.050	–0.295	1	0.065
Sig. (2-tailed)	0.835	0.206		0.791
N	20	20	20	19

Table 7. NIH discharge-age-MOCA correlation with Turkish Sanat Music

	Age	NIH score before discharge	Moca: Overall score	Total Impact of Sanat Turkish Music
Age				
Pearson Correlation	1	0.199	0.050	0.287
Sig. (2-tailed)		0.401	0.835	0.234
N	20	20	20	19
NIH score before discharge				
Pearson Correlation	0.199	1	–0.295	–0.478*
Sig. (2-tailed)	0.401		0.206	0.038
N	20	20	20	19
Moca: Overall score				
Pearson Correlation	0.050	–0.295	1	0.115
Sig. (2-tailed)	0.835	0.206		0.640
N	20	20	20	19

Table 8. NIH discharge-age-MOCA correlation with Classical Music

	Age	NIH score before discharge	Moca: Overall score	Total Impact of Classical Music
Age				
Pearson Correlation	1	0.199	0.050	0.166
Sig. (2-tailed)		0.401	0.835	0.496
N	20	20	20	19
NIH score before discharge				
Pearson Correlation	0.199	1	–0.295	–0.297
Sig. (2-tailed)	0.401		0.206	0.217
N	20	20	20	19
Moca: Overall score				
Pearson Correlation	0.050	–0.295	1	0.083
Sig. (2-tailed)	0.835	0.206		0.736
N	20	20	20	19

often rooted in our memories. Our plan included utilizing the process by which music engages multiple brain regions to aid stroke patients in regaining cognitive functions and improving mood by applying various music genres, aiming to reduce their anxiety and depression levels. Unfortunately, we observed no such effects in our study group over the one-week period, finding no correlation between music therapy and reduced anxiety or depression. However, another study found that patients with depression who listened to music for a five-week period showed significant improvements in depression measures, sleep quality, and quality of life.[10]

These findings suggest that when a music-based intervention is added to standard care, it shows promise for treating depressive disorders and other neuropsychiatric conditions due to its ability to alter brain cognitive functions.

In our experiment, we used a questionnaire to gauge patients' enjoyment of the music and their preferred genres. The results showed that most patients enjoyed the sessions, indicating that music impacted their mood. Specifically, patients with mild or minimal severity, lower NIH scores, and lower depression levels showed more enjoyment. This could be because the response to music depends on which brain region is affected and the degree of disability caused by the stroke. In depression, areas like the medial orbital frontal cortex, the Nucleus Accumbens, and the ventral striatum, which are crucial for reward processing, are less functional or dysfunctional.[11]

Therefore, our results could be attributed to lower activation in the neural networks involved in reward processing in patients with higher depression levels or greater disability due to stroke. Once these areas are damaged, there may be a disconnect between listening to music and experiencing enjoyment, making it difficult for patients to engage with and enjoy music.

Conclusion

Our study indicates a correlation between patients' interaction with and enjoyment of music and the severity of their disability from stroke, as well as their levels of mental illness, such as depression, anxiety, and dementia. From these findings, we can objectively suggest that music has the potential to be a powerful tool in post-stroke rehabilitation for survivors.

Given the outcomes of our research, further detailed investigations are warranted to better comprehend the brain structures directly affected by music. This understanding could be instrumental in harnessing music to influence neuroplasticity, thereby effectively utilizing it as a rehabilitation method. Such an approach could enhance overall health, strengthen sound perception through rhythm and melody, and improve language comprehension abilities through lyrics and singing, as well as speech frequency and rhythm.

The scope of this study was limited to the short term, without delayed measurements of music's effects, which constrains the generalizability of our results regarding the impact of music on the cognitive skills of stroke patients. These limitations could be attributed to the brief exposure period to music, the absence of follow-up assessments, and the reduced number of patients enrolled due to external constraints. A study with a larger sample size could more comprehensively examine the effects of music therapy on motor skills, cognitive functions, and levels of depression or anxiety.

Disclosures

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