Journal of High School Science

The impact of live versus recorded classical music on friends and family of patients in an ambulatory surgical waiting room: a randomized trial

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Submitted: October 19, 2025, Revised: version 1, December 2, 2025
Accepted: December 5, 2025

Abstract

Effective healthcare involves supporting not only patients but also their friends and family members. Those awaiting loved ones in ambulatory surgical waiting rooms often experience anxiety. Music can reduce anxiety, but to our knowledge, no studies have directly compared the effects of live versus recorded classical music on anxiety among friends and family members of patients in this setting. In a randomized trial at a 451-bed community hospital, 120 adult friends and family members of patients were assigned to either a 45-minute live violin performance (n = 60) or a recording of the same repertoire (n = 60). State anxiety was measured before and after the intervention using the State-Trait Anxiety Inventory-State (STAI-S). Baseline STAI-S scores were similar between groups. Anxiety decreased modestly after both interventions; and reached significance after recorded music: live music ($\Delta = -0.40$ [95% CI −1.95 to 1.15], $d = 0.07$, $p = 0.58$) and recorded music ($\Delta = -1.00$ [95% CI −2.01 to 0.01], $d = 0.26$, $p = 0.047$). The between-group difference ($\Delta = 0.60$ [95% CI −1.25 to 2.45]) was not significant ($p = 0.52$). Both live and recorded classical music produced modest reductions in anxiety among friends and family of patients; only the recorded group showed a statistically significant decrease. There was no significant difference between the live and recorded interventions. Recorded music may offer a practical, low-cost approach to supporting the well-being of friends and family members in ambulatory surgical waiting rooms.

Keywords

Music intervention, Anxiety reduction, Ambulatory surgical waiting room, Randomized controlled trial, Caregiver well-being, Live versus recorded music, Health psychology, Classical music performance, Stress management, Psychosocial support

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https://doi.org/10.64336/001c.153899

Introduction

Friends and family of patients often feel anxious while waiting for their loved ones to undergo medical procedures. Anxiety can be heightened by uncertainty about the outcome and the stressful atmosphere of the ambulatory surgical waiting room. Previous research has shown that music can help reduce anxiety, with classical music having a remarkably calming effect (1). Medical institutions have increasingly incorporated music into their environments, often as background music. Music is now widely recognized as an established therapeutic intervention, benefiting patients with a range of conditions, including cancer, psychiatric and neurological disorders, developmental disabilities, and autism (2-4).

Music's positive impact extends beyond direct patient care. Studies have demonstrated its effectiveness in reducing anxiety across a variety of healthcare settings, including emergency department waiting rooms, preoperative areas, intensive care units, and mental health facilities (5-7). Live music interventions have also shown promise as a strategy for reducing stress among students awaiting treatment at a university health clinic (8). More recently, a review of waiting room studies found that background music can foster more positive experiences and may reduce anxiety in healthcare environments (9).

Of particular relevance, Tilt *et al*. (10) conducted a randomized controlled trial in an emergency department. They found that background classical music reduced anxiety among the friends and family of patients with lower formal education or limited musical experience. These findings suggest that demographic factors may influence the effects of music in healthcare settings, underscoring the importance of identifying not only whether music reduces anxiety but also which groups benefit most from it.

Although research on music therapy continues to expand, to our knowledge, no studies have examined how live and recorded music differentially affect anxiety in ambulatory surgical waiting rooms. The present study is the first to investigate the effects of live versus recorded classical music on anxiety levels among friends and family of patients awaiting scheduled elective procedures. Conducted in the ambulatory surgical waiting room of a 451-bed tertiary care community hospital in a medium-sized city, this research aims to clarify whether one form of music delivery offers superior benefits for friends and family members' well-being in a high-stress clinical environment. Neuroimaging evidence Trost *et al*. (11) demonstrated that live music stimulates the affective brain regions of listeners more strongly and consistently than recorded music, engaging more areas of the brain. This effect has been attributed to the live performer's adaptability and the dynamic nature of in-person performance, which creates stronger interpersonal connection between performer and the audience. Accordingly, the present study hypothesized that live classical music would produce a greater reduction in anxiety among friends and family members than recorded music, attributable to its multisensory engagement of both auditory and visual pathways.

Methods

Study design and setting

This study compared the effects of live versus

recorded classical music on anxiety among friends and family of patients awaiting elective medical procedures. Conducted in the ambulatory surgical waiting room of a 451-bed tertiary care community hospital located in a medium-sized city.

This study was reviewed by the St. Joseph's Health / St. Peter's Health Partners Institutional Review Board, which determined it to be exempt under 45 CFR 46.104(d)(3), as it involved benign behavioral interventions with adult participants. All participants provided informed consent, and all data were collected anonymously to protect confidentiality (IRB #25-0306-1).

Participants

A total of 157 participants enrolled in the study and were randomized to either the live or recorded intervention. One hundred twenty participants completed all study procedures and were included in the final analyses. Participants who did not complete the post-intervention survey or who left the waiting area early were excluded from analysis.

Eligible participants were adult friends and family members accompanying patients undergoing scheduled elective procedures. All participants were required to speak English and provide informed consent before participation.

Randomization

Participants were assigned to one of two groups —live music ($n = 60$) or recorded music ($n = 60$) —using block randomization to ensure balanced allocation across groups throughout data collection.

Interventions

Participants were randomized to either a live performance or a recorded playback of identical repertoire. The live music group included participants who listened to an in-person violin performance of classical repertoire. The recorded music group listened to high-quality audio recordings of the same repertoire by the same performer, presented through a portable wireless speaker (Sony SRS-XG300; Sony Corporation, Tokyo, Japan) in the waiting area. Each intervention session lasted 45 minutes.

Metrics

The *State–Trait Anxiety Inventory (STAI)* was administered to measure anxiety. The STAI distinguishes between two constructs: state anxiety (*STAI-S*), which measures temporary emotional states reflecting situational anxiety; and trait anxiety (*STAI-T*), which measures general predisposition to anxiety considered stable over time (12).

For this study, only state anxiety scores were measured pre- and post-intervention, as the focus was on situational stress within the waiting-room context. Demographic data were collected, including age, gender, educational attainment, history of mood or anxiety disorders, prior musical experience, and relation to the surgical patient.

Statistical analysis

Data were consolidated and analyzed using Excel for data management and RStudio for statistical testing. Independent *t* tests were used to compare continuous variables between groups, while χ^2 tests were applied to categorical variables. Pre- and post-intervention anxiety scores were compared within groups using paired-samples *t* tests, and mean changes in anxiety were compared across groups using

independent *t* tests. Statistical significance was set at $p < 0.05$. Assumptions of normality and homogeneity of variance were tested with Shapiro–Wilk and Levene's tests, confirming suitability for *t* tests.

Results

Of 157 participants enrolled, 120 (76.4 %) completed both surveys and were included in analyses (live $n = 60$, recorded $n = 60$); 37 participants (23.5 %) withdrew or left early (see Figure 1).

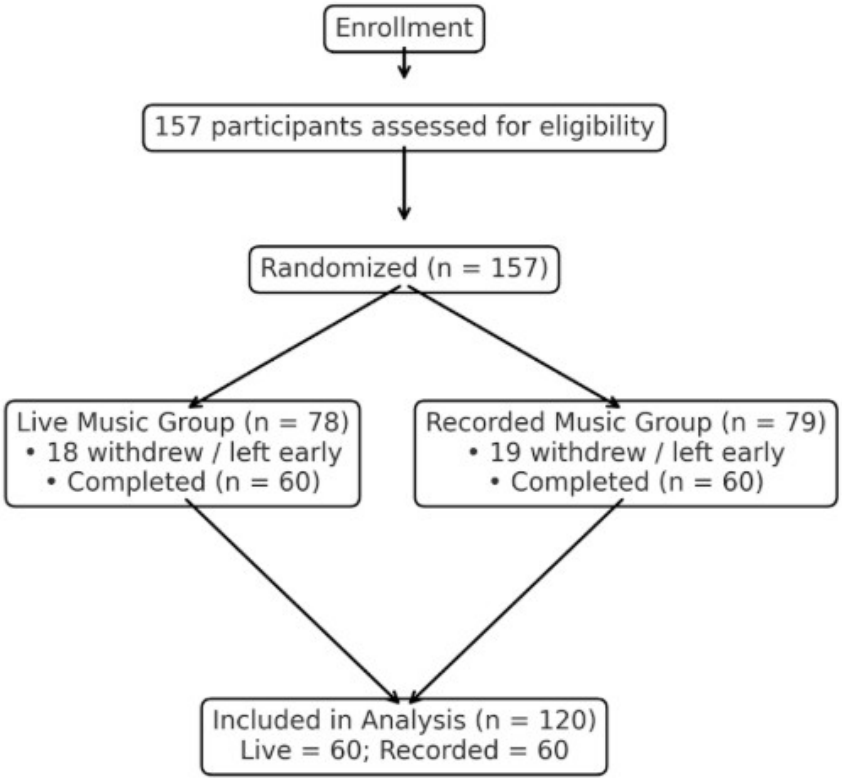

Figure 1. CONSORT flow diagram of participant enrollment, randomization, and inclusion in final analysis. Of 157 participants enrolled, 120 (76.4%) completed both pre- and post- intervention assessments (live n= 60, recorded n=60).

Participant characteristics

The two groups were broadly comparable across demographic and baseline variables, with no significant differences in age, gender, history of mood or anxiety disorder, music experience, or enjoyment (see Table 1). There were also no significant differences between the groups in participants' relationships with the patient or perceived procedural risk.

Table 1. Patient demographics

Total Number Per Group	Live Music (N=60)	Recorded Music (N=60)	
Characteristic	**N (%) or Mean (SD)**	**N (%) or Mean (SD)**	***p*-Value**
Age (years)	56.3 (14.9)	52.5 (16.7)	.20
Gender, Female	41 (68.3%)	32 (53.3%)	.13
Highest Completed Education Level			.03*
High School	26 (43.3%)	22 (36.7%)	
College	15 (25.0%)	29 (48.3%)	
Post-Graduate	18 (30.0%)	8 (13.3%)	
Hx of Mood/Anxiety Disorder (Yes)	11 (18.3%)	7 (11.7%)	.44
Experience playing an Instrument (No)	38 (63.3%)	39 (65.0%)	1.00
Listening Enjoyment (1-5; 1=Very Little, 5=Very Much)			.34
4 or 5	50 (83.3%)	51 (85.0%)	
Relation to Surgical Patient			.67
Spouse/Partner	25 (41.7%)	24 (40.0%)	
Parent	15 (25.0%)	11 (18.3%)	
Child	7 (11.7%)	14 (23.3%)	
Sibling	6 (10.0%)	5 (8.3%)	
Friend	3 (5.0%)	3 (5.0%)	
Other Family	4 (6.7%)	3 (5.0%)	
Subjective Riskiness of Procedure (1-5; 1=Very Low, 5=Very High)			.56
5-Very High	13 (21.7%)	9 (15.0%)	
4	5 (8.3%)	4 (6.7%)	
3	24 (40.0%)	32 (53.3%)	
2	15 (25.0%)	14 (23.3%)	
1-Very Low	3 (5.0%)	1 (1.7%)	

*$p<0.05$

Note. Values represent M (SD) or n (%). $p < .05$ indicates statistical significance.

A significant difference was observed in educational attainment ($p = 0.03$), with the recorded music group having more participants with a college degree and fewer with postgraduate education compared with the live music group. This imbalance is notable given prior findings Tilt *et al*. (10), suggesting that educational background may influence music's anxiety-reducing effects.

Participants across both groups were middle-aged on average, with a mean age of 56.3 years (SD = 14.9) in the live music group and 52.5 years (SD = 16.7) in the recorded group. The majority of participants across both groups were female, with 68.3% of the live group and 53.3% of the recorded group identifying as female. About two-thirds of all participants reported playing a musical instrument, and more than 80% rated their enjoyment of music listening as

high (scores of 4–5). A small number of participants reported a history of mood or anxiety disorders (18.3% in the live group; 11.7% in the recorded group). Most participants were either spouses or close relatives of the patients, and perceived procedural-risk ratings were similar between the two groups.

State anxiety outcomes

Baseline state anxiety scores did not differ significantly between the two groups: 45.5 (SD = 5.4) for the live group and 46.0 (SD = 6.9) for the recorded group. Post-intervention scores were also similar: 45.0 (SD = 5.2) for live and 44.9 (SD = 7.6) for recorded (see Table 2).

Table 2. State Anxiety

Total Number Per Group	**Live Music (N=60)**	**Recorded Music (N=60)**
Characteristic	**Mean (SD)**	**Mean (SD)**
Pre-Intervention State Anxiety Score	45.5 (5.4)	46.0 (6.9)
Post-Intervention State Anxiety Score	45.0 (5.2)	44.9 (7.6)
State Anxiety Score Difference	-0.4 (6.00)	-1.00 (3.90)
Characteristic	***p*-Value**	***p*-Value**
Score Difference Within Intervention	.58	.047*
Score Difference Between Interventions	.52	

*$p<0.05$

Note. Negative change values indicate reductions in anxiety. $p < .05$ indicates statistical significance.

Within-group analyses showed a significant reduction in anxiety in the recorded group (mean change = −1.00, SD = 3.90, $p = 0.047$). The live group also showed a slight decrease (mean change = −0.40, SD = 6.00, $p = 0.58$), but this change was not statistically significant. The between-group difference in mean change was nonsignificant ($p = 0.52$).

Figure 2 illustrates the similar pre- and post-intervention patterns for both groups, highlighting that although recorded music produced a small statistically significant decrease, overall anxiety levels followed comparable trends across interventions.

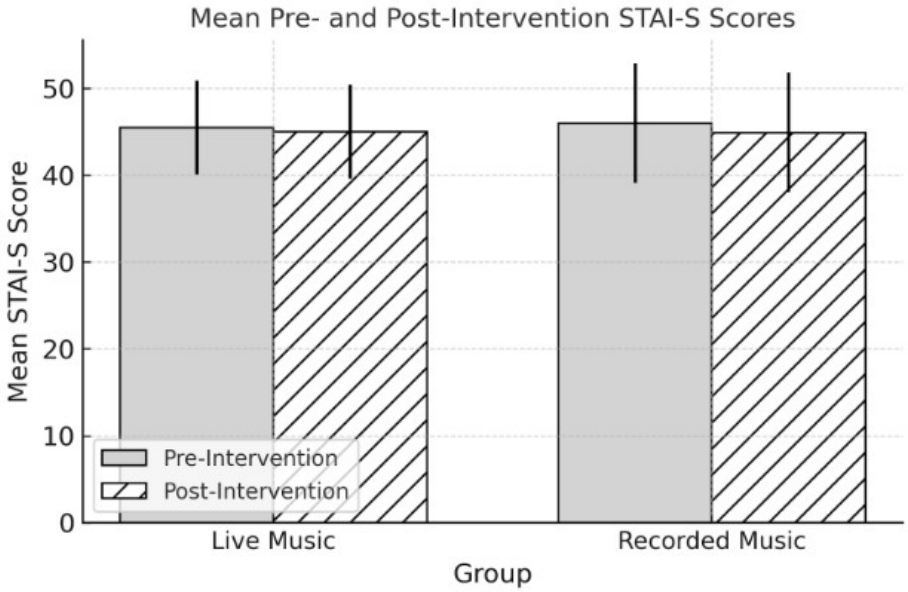

Figure 2. Mean pre- and post- intervention STAI-S scores for live and recorded music groups (error bars = ± 1 SD)

Discussion

In this study, we compared the effects of live performance and recorded classical music on anxiety among friends and family of patients waiting in an ambulatory surgical waiting room. Both interventions produced modest reductions in state anxiety; however, only the recorded music condition reached statistical significance. Contrary to our hypothesis, live music did not reduce anxiety more than recorded music.

As shown in Figure 1, both groups followed similar pre- and post-intervention trends, with recorded music producing a slightly greater reduction. This pattern suggests that while live performance did not outperform recorded music, both forms of exposure contributed to small but meaningful decreases in situational anxiety.

These findings contrast with the initial hypothesis that live music would have a greater effect due to the performer's presence and the dual sensory stimulation of sight and sound. One possible explanation is that recorded music allows participants to focus solely on the auditory experience without the cognitive demands of evaluating a live performance. The variability inherent in live music—changes in tempo, dynamics, or performer expression—may increase cognitive load for some listeners, offsetting its potential calming effects. Conversely, recorded music provides predictable, consistent auditory input, which may better support relaxation for those relying on distraction as a coping mechanism. Some listeners might also have absorbed the performer's subtle tension, amplifying their own anxiety.

Participants in the live music group, who had a higher proportion of postgraduate education, may have engaged more analytically with the performance, diminishing its soothing effect. This evaluative mindset could explain their smaller anxiety reduction. Additionally, differences in instrumentation and performer expertise may have influenced outcomes. Unlike the study by Trost *et al*. (11), which used piano performance, this study employed solo violin music, which can be perceived as more intense or less harmonically rich without accompaniment. The performer's high-school proficiency level, while accomplished, likely differed from that of a professional musician. The selected classical repertoire may also have shaped participants' responses.

Taken together, the present findings and those of Tilt *et al*. (10) underscore that although music reliably reduces stress in high-anxiety settings, both the delivery mode and individual listener characteristics can influence its effectiveness. Future studies incorporating qualitative methods to capture participants' subjective experiences may help clarify the mechanisms underlying these effects. Examining factors such as accompaniment, performer professionalism, and the use of more familiar or contemporary repertoire could also yield new insights. Beyond anxiety reduction, recorded classical music may contribute to a calmer, more welcoming environment for patients' friends, family members, and healthcare staff. Because it is low-cost and easily implemented, it represents a practical intervention for ambulatory surgical centers and other outpatient facilities.

Limitations

A key limitation of this study was participant attrition: 23.5 % of participants did not complete all questionnaires or left the waiting room before the intervention concluded. Several participants indicated that they would have been more willing to remain if the total session time had been clearly described as a 45-minute intervention. More accurately communicating or modestly shortening the expected duration may improve participant retention and data completeness in future research. Individuals who left early or did not complete the surveys may have done so because of elevated anxiety, which creates the possibility of attrition bias. Attrition bias occurs when participants who drop out of a study significantly differ from those who remain. Statistical tests assume that the analyzed sample represents the randomized groups. If caregivers with higher anxiety were more likely to leave, the observed changes in anxiety may not fully reflect the true effects of the interventions.

Another limitation is the absence of a no music control group. Without a group that received no musical intervention, it is not possible to determine whether the modest reductions in anxiety were caused by the music, by regression to the mean, or by a natural decline in anxiety over time as caregivers adjusted to the waiting room environment. This limitation affects how confidently the within-group changes in STAI-S scores can be interpreted. Future studies could incorporate a no music control condition and measure acoustic parameters to strengthen internal validity. As well, such studies could standardize sound levels, ambient noise, and time of day to ensure that environmental factors do not influence outcomes.

The study also used a parallel group design rather than a crossover design. In a crossover design, each participant serves as his or her own

control, which can reduce variability between individuals and increase the ability to detect small differences between interventions. In this ambulatory surgical setting, friends and family were present for only a single surgical event, so it was not practical to expose the same individual to both live and recorded music. Randomization was therefore used to balance baseline anxiety levels between groups. This design was appropriate for the clinical context, but it may have reduced listeners' sensitivity to subtle differences between live and recorded music. Consequently, the finding of no significant difference between the interventions should be interpreted with caution.

In addition, subgroup analyses examining whether education level moderated responses to live versus recorded music were not conducted. Given prior findings (10), the observed imbalance in education between groups may have influenced outcomes. The study's analyses also did not use ANCOVA, the analysis of covariance, to adjust for baseline STAI-S scores or education level, hence residual confounding by these factors cannot be ruled out. Future work could apply ANCOVA and prespecified subgroup analyses to provide more precise estimates of any differences between live and recorded music across subgroups of friends and family members.

Conclusion

Both live performance and recorded classical music modestly reduced anxiety among friends and family members of patients in the ambulatory surgical waiting room. However, only the recorded music condition reached statistical significance. There was no significant difference in anxiety reduction between the two interventions, suggesting that live music is not necessarily more effective than recorded music in this setting. Recorded music may offer a practical and cost-effective way for hospitals to enhance the waiting room experience and promote well-being in clinical environments. Several factors—including education, prior musical experience, performer expertise, and repertoire choice—may influence the relative impact of live and recorded interventions. Future studies should examine these variables in greater depth, including comparisons of solo versus accompanied performances, professional versus student performers, shorter interventions, and a broader range of musical genres.

Acknowledgments

The author thanks Dr. Nathan Kung for his guidance as project mentor and Christian Lee for assistance with data collection. Gratitude is also extended to the staff and participants at St. Joseph's Health Ambulatory Surgery Center, whose cooperation made this study possible.

Classical music compositions for solo violin (together lasting ~ 45 minutes)

J.S. Bach – Violin Sonata No. 1 in G Minor, BWV 1001, Adagio, Siciliana

J.S. Bach – Partita No. 3 in E Major, BWV 1006, Loure, Gavotte en Rondeau, Menuets I & II, Bourrée, Gigue

J.S. Bach – Partita No. 2 in D Minor, BWV 1004, Allemanda, Courante, Sarabanda, Ciaccona

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