Original Article

Application of Therapeutic Harp Sounds for Quality of Life Among Hospitalized Patients

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Abstract

Context. Hospitalized patients experience symptoms including pain and anxiety that may negatively affect their well-being and overall quality of life (QOL), even when medical interventions are deemed successful.

Objectives. The objective of the study was to assess the efficacy of prescriptive live therapeutic harp sounds on patient symptoms and QOL.

Methods. The study was a two-period, two-treatment arm crossover, randomized clinical trial. Individuals were randomized to harp music and standard care for the first 24 hours of the hospital stay, followed by 24 hours of only standard care, or vice versa. The harp intervention was 30–40 minutes of prescriptive live therapeutic harp sounds in the form of solo harp pieces and improvisations. Patients recorded well-being and symptom scores on linear analogue scales. Entry criteria included at least 18 years and a score of 3 or below on a 1–5 linear analogue scale indicating compromised overall QOL.

Results. Ninety-two eligible patients participated in the clinical trial. All the QOL variables had significantly higher percentages of patients with improvements during the harp treatment than during standard care. Five symptoms—fatigue, anxiety, sadness, relaxation, and pain—were significantly improved following therapeutic harp treatment. Approximately 30% to 50% of patients showed a significant increase in the QOL measures after harp treatment.

Conclusion. There is evidence of strong positive effects on the QOL of hospitalized patients who received therapeutic harp sound treatment along with standard care. J Pain Symptom Manage 2015;49:836–845. © *2015 Published by Elsevier Inc. on behalf of American Academy of Hospice and Palliative Medicine.*

Key Words

Music, quality of life, crossover, clinical trial, therapeutic harp

Introduction

Music has long been recognized informally for its physiological and psychological effects in the health care setting.[1] Watkins[2] theorizes that there is a potential connection between sensory input from music and neural output—central nervous system (CNS) and autonomic nervous system (ANS). The ANS changes have been studied for nearly 125 years,[3] with emphasis on almost every ANS organ. From this, it has been proposed that the ANS system could serve as the mechanism by which music can apply its effects on humans.[3,4] Music has long been associated with relaxation[5] and has spawned an entire professional field of music therapy with distinct certification and academic literature.[6] It is speculated that the auditory neural impulses respond in unique ways to the sound wave frequency, amplitude, and timbre of music. These impulses "may mediate changes in blood pressure, heart rate, and anxiety level by affecting release of corticotrophin-releasing hormone from the hypothalamus or release of norepinephrine from the locus ceruleus/sympathetic nervous system."[2,3] However, in many cases assessing ANS responses to frequency

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were considered secondary to the person's "state" such as anxiety.

The therapeutic effects of music have been demonstrated to include evoking a range of emotional and physiological responses including, but not limited to, arousal, mood, and motor response including respiratory patterns.[7] There are various studies in the fields of nursing and medicine that suggest that music is effective as an anxiolytic intervention for patients experiencing stress and/or pain.[2,8–12] The harp, an acoustic stringed instrument, is believed to be effective because the plucking of its multiple strings can produce a wide range of vibrations and overtones (harmonics) that can resonate in a complementary way with the complex and vast range of cellular vibrations in the human body and mind. Although patients may not be hearing every tone of the harp with their ears, they are still receiving the vibrations as resonance, which enters the body and is transmitted throughout the skin, bone, muscles, and CNS.

Because of this, a plausible explanation for the effects of music on the human body may lie in a relationship between the vibrations in the human body and those of the music therapy being administered.[13] Movement of atomic components within the body creates a constant sound vibration that can be affected by sound vibrations from external sources.[14] Musical sound vibrations that resonate with the human vibratory pattern, therefore, could have an effect on the human body.

Entrainment is the process by which there is change in the vibration pattern of one object based on the similar stronger vibration of another object.[14] Thus, the process of entrainment is one of the ways in which the vibrational patterns of the patient's body and mind may be influenced by the intentional sequencing of tones and rhythms of the harp vibrations, which leads to changes in how symptoms are experienced. The entrainment of body rhythms with relaxing music is thought to decrease the arousal of the sympathetic nervous system, thus contributing to relaxation and anxiety reduction.[15] For example, steady, slow, and repetitive rhythms are used to exert a hypnotic or relaxing effect.

One study involved a single 20-minute session of live harp playing administered to 17 vascular and thoracic post-surgical patients being physically monitored for heart rate and other measurable functions. Live music was chosen because of the harp therapist's ability to observe the patients' reactions and then tailor the intervention to their specific needs.[16] Results indicated that listening to live harp music had a positive effect on patient perception of anxiety, pain, and satisfaction, and produced statistically significant differences in physiological measures of systolic blood pressure and oxygen saturation.

The purpose of the present study was to further explore the effects of therapeutic music on clinical outcomes of hospitalized patients, using both physiological and psychosocial outcomes via patient-reported questionnaires. Quality of life (QOL) domains reflect the potential impact on multiple domains of physiological and psychosocial outcomes beyond treatment outcome.[17] Patients who have been a part of successful medical interventions, such as surgery and medication, may still experience distressing symptoms such as anxiety or pain that cannot necessarily be relieved by further surgery or medication and, therefore, experience deficits in QOL despite treatment success.[18] Deficits in QOL among patients have been shown to be prognostic for a number of clinical outcomes including survival.

Methods

Study Design

A randomized, controlled, two-period crossover clinical trial was conducted under Institutional Review Board approval. A crossover design was used to ensure that not only did all patients receive the treatment intervention but that they could serve as their own control (Fig. 1).[19] A double-blind research study was not possible because of the nature of the intervention. After providing written informed consent, patients were randomized to one of the two groups. Group 1 received harp music on Day 1, then standard care after. Group 2 received standard care on the first day, then the harp music on Day 2. Both groups would receive a 30–40 minute intervention of individualized harp music on a given day and routine care on another.

Patient Eligibility

The eligibility criteria for this study included 1) QOL score at 3 or below on a 1–5 point Likert scale where zero was considered the worst possible and five was best possible; 2) life expectancy greater than three days; 3) expected length of hospital stay of at least three days; 4)18 years or older; and 5) ability to complete the survey. Although the ability to complete the survey was a requirement for patient eligibility, patients were not obligated to do so; they just had to demonstrate the capacity to do the task. Research assistants evaluated all referred patients to ascertain eligibility. Referrals were made based on the following symptoms: anxiety, pain, shortness of breath, agitation or distress, or any combination of symptoms resulting in suspected lowering of patients' global QOL. Patients were included or excluded based on their reported symptoms, not their diagnosis. Hence, the study was symptom-driven rather than diagnosis-driven. A Patient Referral Tool, completed by the research assistant, included details for the therapeutic harpist on patient diagnosis, and symptoms. It also

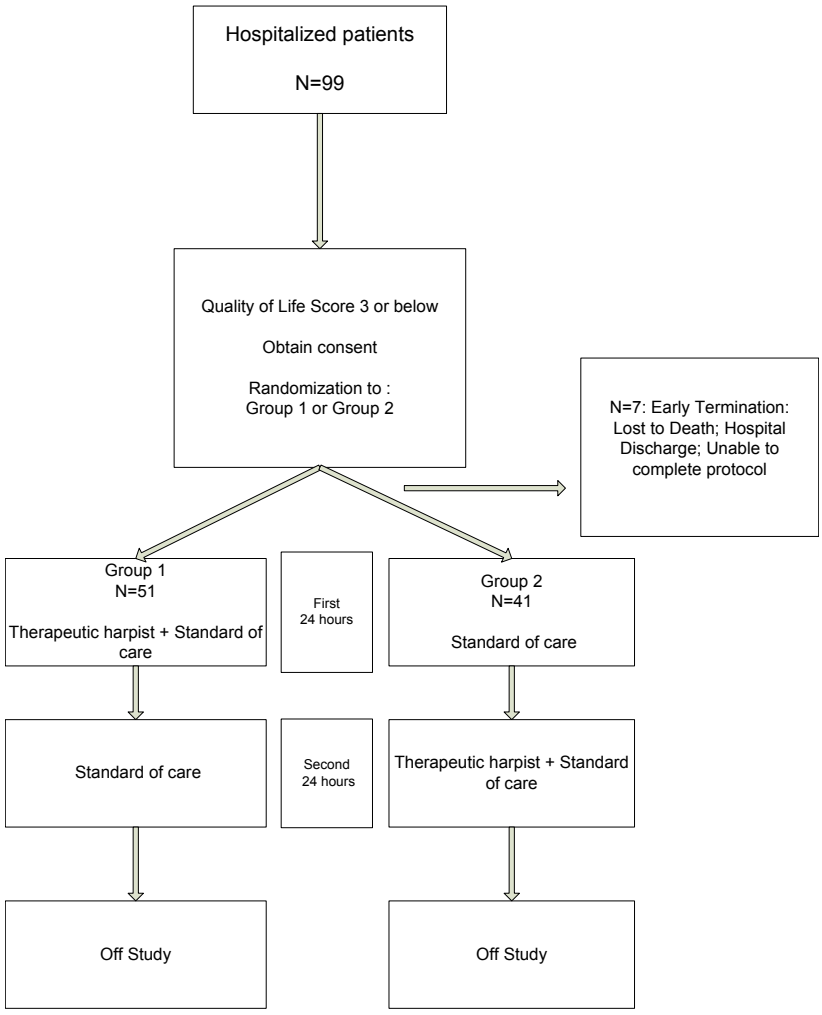

Fig. 1. Study design. This figure illustrates the randomized, controlled two-period crossover clinical trial design described in full under the methods section. Here, hospitalized patients who scored a three or below on their LASA would be eligible for the study. After the participant signed the consent, they would be randomized to either Group 1, harp therapy in addition to standard care, or Group 2, standard care, for the first 24 hours. After the initial 24 hours, both groups would switch treatments and thus Group 1 would then receive only standard care, whereas Group 2 would now receive harp therapy in addition to standard care. The study would conclude after 48 hours.

included information on consent, randomization, and dates and times of intervention.

Description of Intervention

The intervention section of the trial was conducted by a conservatory-trained musician (D. M. S.) with more than 10 years experience in providing harp vibration therapy. The therapist received referrals of qualified patients within an hour preceding the intervention. This referral was sent out by the research assistant, who also randomized the patients at this time. The research assistant then selected a randomization envelope, which enclosed an individual card that listed either Group 1 or Group 2. If the participant was randomized to Group 1, the intervention was then administered and within an hour following the intervention, the research assistant collected the post-intervention data (Linear Analogue Self-Assessment [LASA] scale and other items such as blood pressure and heart rate). If the participant was randomized to Group 2, the LASA and other outcome measures[3] were taken directly after the participant was randomized to standard care. On additional standard care days (Day 2 for Group 1), the same measurements were taken at approximately the same time of day the intervention took place on the previous day.

The therapeutic harpist followed a uniform procedure and sequence with each patient. First, the Patient Referral Tool was reviewed with the patient's nurse or physician within the context of the patient's medical record. The harpist would introduce herself to the patient by using a script. She would then ask a few questions to determine what specific symptoms needed to be addressed such as "Are you in pain right now?" or

Table 1
Demographic Information

	Music Followed by No Music ($n = 51$)	No Music Followed by Music ($n = 41$)	Total ($n = 92$)
Age (yrs)			
N	51	39	90[a]
Mean (SD)	63.3 (18.70)	62.5 (17.96)	63.0 (18.29)
Median (Range)	69.0 (19.0–87.0)	64.0 (18.0–88.0)	67.0 (18.0–88.0)
Gender, *n* (%)			
Female	39 (76)	26 (63)	65 (71)
Male	12 (24)	15 (37)	27 (29)
Condition, *n* (%)			
Missing	1 (2)	1 (2)	2 (2)[a]
Medical condition	29 (57)	30 (73)	59 (64)
Surgical	21 (41)	10 (24)	31 (34)
Overall QOL: 0 = bad to 5 = good			
N	45	38	83[a]
Mean (SD)	2.5 (0.73)	2.7 (0.45)	2.6 (0.62)
Median (Range)	3.0 (0.0–3.0)	3.0 (2.0–3.0)	3.0 (0.0–3.0)

[a]Some of the 92 participants chose not to answer the questions.

"What would you like help with right now?" and "Is there any kind of music you do, or do not, want to hear?" Finally, "Would you like to receive the harp music now?" If the patient responded "yes," others were asked to leave the patient's room for the duration of the treatment. This was done to protect the privacy of the patient and ensure that the patient's physical and emotional responses would not be influenced by the presence of others.

Because a standardized, recognized protocol of therapeutic harp technique does not exist, the harpist created and administered a therapeutic harp vibration protocol tailored to each study patient. Music chosen included 1) set pieces chosen by the patient or by the therapeutic harpist including Celtic, classical, folk, country, inspirational, religious, or other styles; and 2) improvisations composed at that moment to address the patient's individual condition. The harpist examined the patient's verbal and nonverbal cues indicating their responses throughout the 30–40 minute intervention. These cues included respiration quality, patterns, and rates; movement of extremities; facial expression; emotional reactions such as tears or anger; body tension and position; and verbal comments. Based on these cues, the harpist would then adjust different aspects of the music being administered, including tempo, key, rhythm, volume, chordal structure, and plucking techniques. The harpist employed classical Salzedo techniques, and used a gut-strung Lyon & Healy Troubadour harp of 33 strings.

Outcome Measures

Physiological Measures. Blood pressure, respiration rate, and heart rate were taken daily throughout the study using an automatic cuff. The first reading took place at the consent visit, followed by once a day during survey collection. These physiological measures were included as they are known to be related to QOL domains and symptoms such as anxiety and have been included in previous studies examining the impact of music therapy on physical functioning.[20]

Patient-Reported Outcomes. This study used the single-item LASA scale or UNISCALE, which is a linear analogue scale assessing the overall QOL. The LASA is an eight question questionnaire that uses 0–5 scales to assess overall QOL as a primary endpoint. The LASA's overall score illustrates zero as a terrible overall QOL and five as an overall good QOL. Question 5 of the eight questions is used to determine the participants' eligibility in the study because this question states, "How would you rate your overall well-being right now?" Additionally, a 1–5 point Likert scale was used as a post-intervention tool to assess the subjects' overall well-being. The subjects' baseline answer to question five was used to assess if they were eligible for the study. If the subjects rated themselves as a three or below on Question 5, they were included in the study.

End-of-Study Questionnaire. At the end-of the study, participants were asked about their opinion on the harp therapy and if they found it to be beneficial. The question used a 1–5 point Likert scale and defined "improvement" as answering three (somewhat) to five (very much) on the survey. The survey impression is illustrated in Table 5.

Statistical Analysis

The primary analysis was a comparison of post-treatment (first 24 hours) average QOL between the two groups. Supplementary analyses of the primary endpoint were a comparison of average change from baseline to the first 24 hours between

Table 2
Rank Sum Test *P*-values for the Change in Value From Before to After the Intervention

	Carryover Test *P*-value	Crossover: Number of SDs Difference Harp-No Harp	Crossover Test *P*-value	First Period: Number of SDs Difference Harp-No Harp	First Period Test *P*-value
QOL measures					
Physical well-being	0.4633	0.69	**0.0034**	0.35	0.1103
Emotional well-being	0.5451	1.00	**<0.0001**	0.79	**0.0004**
Spiritual well-being	0.3696	0.68	**0.0030**	0.53	**0.0094**
Intellectual well-being	0.1071	0.50	**0.0203**	0.48	**0.0128**
Overall well-being	0.8225	1.07	**<0.0001**	0.69	**0.0015**
Fatigue	0.5633	0.61	**0.0070**	0.41	**0.0202**
Nausea	0.8708	0.32	0.7539	0.22	0.8453
Anxiety	0.1648	1.15	**<0.0001**	0.95	**<0.0001**
Sadness	0.1196	0.85	**0.0001**	0.98	**<0.0001**
Pain	0.7667	0.47	**0.0379**	0.43	0.2330
Relaxed	0.1572	1.16	**<0.0001**	0.98	**0.0001**
Overall quality of life	0.7553	1.46	0.2780	0.67	0.0605
Vital signs					
Diastolic blood pressure	0.9353	−3.12	0.1858	−1.87	0.5100
Systolic blood pressure	0.1225	−6.05	0.2803	−0.21	0.9967
Heart rate	0.5403	−8.29	**0.0051**	−3.15	0.2938

The *P*-value is obtained for each endpoint and used to assess any carryover effects that may have occurred during the cross over study. All significant *P*-values are indicated in bold.

groups via a *t*-test and a comparison of the proportion of patients reporting a clinically significant change across groups via Fisher's exact test. The difference in the self-report linear analogue assessment just after the intervention relative to the value reported before the intervention provided evidence of the short-term efficacy. Comparison of the primary endpoint was carried out by standard two-sample treatment comparisons (e.g., *t*-tests and Wilcoxon rank sum tests supplemented by Shapiro-Wilk normality testing). All comparisons between therapeutic harp intervention with standard care and the standard care alone intervention used two-sided alternatives and 5% Type I error rates.

Secondary analyses using both crossover periods (first 24 hours and second 24 hours) included constructing a general linear model to ascertain the impact of potential confounding covariates on the primary outcome. These models are specifically designed for crossover trials.[12] Two-stage crossover analyses also were used to analyze the carryover and crossover effects using both study periods.[21] Each of the secondary endpoints was analyzed in a manner similar to that of the primary endpoint.

Table 3
Percent of Patients Achieving a ½ SD Improvement

	Music (%)	No Music (%)	*P*-value
Diastolic blood pressure	34	25	0.2570
Systolic blood pressure	41	30	0.1663
Heart rate	**36**	**21**	**0.0328**
Respiration	7	14	0.1445
Physical well-being	**51**	**23**	**0.0001**
Emotional well-being	**47**	**14**	**<0.0001**
Spiritual well-being	**34**	**4**	**<0.0001**
Intellectual well-being	**30**	**10**	**0.0008**
Overall well-being	**58**	**20**	**<0.0001**
Fatigue	40	29	0.1634
Nausea	21	13	0.2370
Anxiety	**39**	**20**	**0.0056**
Sadness	**37**	**20**	**0.0136**
Pain	29	28	0.9999
Relaxed	**47**	**13**	**<0.0001**
Overall quality of life	21	12	0.1617

Items reported above were considered patient-reported clinically meaningful improvement items. The bold reported measures were clinically significant.

Missing data were dealt with in a number of ways. Intention-to-treat principles were applied to the proportion of successes analyses.[22] In this analysis, missing values were counted as failures. Simple imputation of missing data for the primary and QOL-related secondary endpoints was undertaken as a sensitivity analysis.[23] This included imputation via last value carried forward, minimum/mean/maximum value carried forward, and nearest neighbor estimation alternatives using an algorithm that was developed by our statistical team and has been used in numerous clinical trials.[24] None of the results for the imputed analyses differed from the raw results presented herein.

Power Considerations

A sample of 50 patients per group provided 80% power to detect a difference in overall QOL scores of 0.5 times the SD, using a two-tailed *t*-test with a 5% Type I error rate.[25] This moderate effect size has been identified as a conservative estimate of a clinically meaningful difference for QOL endpoints such as fatigue. Assuming an SD of roughly 17% of the range, this translates into a detectable difference of 8−10 points on a 0−100 point scale. This has been demonstrated to be a reasonable cutoff for clinical significance across a variety of settings for QOL endpoints.

The comparison of the proportion of patients reporting a clinically meaningful improvement had

Table 4
Means and SDs Before and After Treatment in the First 24 Hours

	Music		No Music	
Endpoint	Day 1 Before Treatment	Day 1 After Treatment	Day 1 Before Treatment	Day 1 After Treatment
Physical well-being	2.4 (1.10)	3.2 (1.04)	2.7 (0.94)	3.0 (1.03)
Emotional well-being	3.2 (1.13)	3.8 (1.12)	3.2 (1.02)	3.1 (1.01)
Spiritual well-being	3.9 (1.06)	4.2 (1.05)	3.9 (0.95)	3.9 (0.91)
Intellectual well-being	3.4 (1.10)	3.8 (1.13)	3.6 (1.00)	3.5 (0.92)
Overall well-being	2.7 (0.63)	3.5 (0.88)	2.8 (0.57)	3.1 (0.75)
Fatigue	3.5 (2.64)	4.6 (2.91)	3.9 (2.33)	3.8 (2.52)
Nausea	8.7 (2.62)	9.5 (1.21)	8.7 (2.47)	8.9 (2.28)
Anxiety	5.5 (2.75)	7.4 (2.57)	5.5 (2.86)	5.5 (2.76)
Sadness	6.1 (2.90)	7.6 (2.42)	6.6 (3.03)	6.3 (2.89)
Pain	5.7 (3.18)	7.1 (2.69)	6.4 (3.14)	6.9 (2.73)
Relaxed	4.8 (2.82)	7.1 (2.42)	5.7 (2.72)	5.2 (2.89)
Overall quality of life	42.0 (18.71)	54.8 (20.45)	46.1 (14.63)	49.1 (15.57)
Diastolic blood pressure	68.5 (14.88)	68.2 (14.54)	68.7 (10.01)	70.5 (10.29)
Systolic blood pressure	131.9 (26.23)	130.4 (21.49)	129.23 (17.61)	127.9 (17.73)
Heart rate	79.5 (18.58)	78.3 (18.21)	80.6 (12.30)	82.2 (14.39)
Respiration rate	19.4 (5.68)	20.24 (9.81)	18.1 (3.81)	18.9 (4.15)

80% power to detect differences of 20% between the proportions if the lesser result was no more than 10% (presumably the standard care group). Power considerations for the various secondary endpoints were comparable.

The above power calculations are based on the worst-case scenario of a significant carryover effect. If no such carryover were present, then the power considerations for the comparisons made within the context of the crossover design are better than those stated above by reducing the effect sizes detectable by a factor of the square root of two because of the paired-comparisons nature of the data wherein each patient serves as their own control.[19] This corresponds to the ability to detect, with 89% power, average differences of 0.57 SDs of the continuous QOL scores (7% on a 0−100 point scale) and differences in toxicity incidence rate of 18%. Hence, if no carryover effect is present, we were able to detect any impact of music therapy of moderate effect size or larger.

The presence of a carryover effect was assessed using established sums and differences testing.[26] The complex set of routines constructed for analysis of crossover designs includes analysis of intra-patient differences as well as Bayesian procedures.[22,26,27]

Table 5
Summary of Exit Survey Questions

	Music Followed by No Music ($n = 51$)	No Music Followed by Music ($n = 41$)	Total ($n = 92$)
Harp improved well-being, *n* (%)			
Missing	7 (14)	7 (17)	14 (15)
Not at all	2 (4)	1 (2)	3 (3)
Somewhat	6 (12)	6 (15)	12 (13)
Quite a bit	16 (31)	11 (27)	27 (29)
Very much	15 (29)	13 (32)	28 (30)
No response	5 (10)	3 (7)	8 (9)
Harp reduced anxiety, *n* (%)			
Missing	7 (14)	7 (17)	14 (15)
Not at all	3 (6)	1 (2)	4 (4)
Somewhat	7 (14)	7 (17)	14 (15)
Quite a bit	18 (35)	11 (27)	29 (32)
Very much	11 (22)	10 (24)	21 (23)
No response	5 (10)	5 (12)	10 (11)
Harp reduced pain, *n* (%)			
Missing	12 (24)	9 (22)	21 (23)
Not at all	4 (8)	3 (7)	7 (8)
Somewhat	7 (14)	5 (12)	12 (13)
Quite a bit	13 (25)	6 (15)	19 (21)
Very much	3 (6)	8 (20)	11 (12)
No response	12 (24)	10 (24)	22 (24)
Harpist is valuable, *n* (%)			
Missing	7 (14)	7 (17)	14 (15)
Not at all	1 (2)	1 (2)	2 (2)
Somewhat	1 (2)	3 (7)	4 (4)
Quite a bit	17 (33)	7 (17)	24 (26)

Results

Ninety-nine patients were enrolled at Mayo Clinic Health System - Franciscan Healthcare. Seven patients did not complete the study because of severity of illness, confusion, or discharge, leaving a total of 92 patients in the study. The demographics for each arm are shown in Table 1. Overall, of the 92 individuals accrued in the study, 71% were female and 29% were male. Fifty-one individuals were randomized to Group 1 (first 24 hours), with 76% of those being females and 24% being males. The 41 other individuals were randomized to Group 2 (standard care in the first period); of those, 63% were females and 37% were males. This discrepancy in the arms (51 vs. 41 participants) resulted from the simple randomization that took place without blocking or stratifying the sample. When the participants terminated early, this caused an imbalance in sample arms. The overall age ranged from 18 to 88 years, with a mean of 63 years for 90 of the 92 participants. Two of the individuals did not address age or condition for hospitalization; for this reason only 90 individuals' ages and

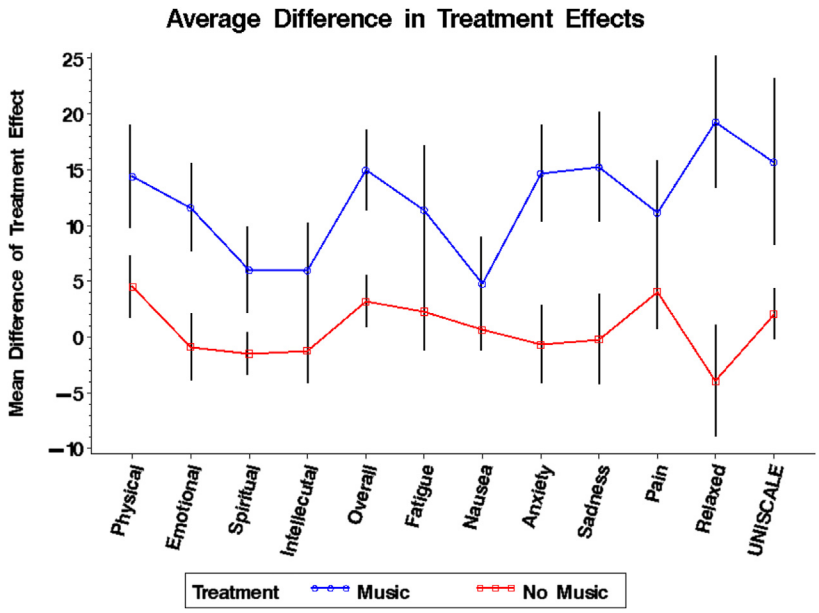

Fig. 2. The average difference in treatment effects when comparing the addition of music vs. standard care only. This figure addresses the average treatment effect differences between only standard care and harp therapy in addition to standard care. Here, the addition of harp therapy is illustrated with circles, whereas standard care only is illustrated with square points. The mean differences with 95% confidence intervals between the two are compared with physical items such as pain, nausea, and emotional items such as overall quality of life and anxiety.

conditions were taken into account. The overall conditions for which the participants were in the hospital included medical condition (64%) or surgical procedure (34%). The 1−5 Likert scale was administered for 83 of the initial 92 participants. This scale illustrated an overall mean well-being of 2.6 (+/− 0.62), with an input range of 0.0 to 3.0.

The individual QOL measures along with the overall QOL post-intervention are illustrated in Table 2. Each QOL measurement's *P*-value (for physical well-being to overall QOL) is listed for both the initial first period and the crossover assessment (first and the last 24 hours). The crossover assessment is designed to address the before and after effects of music therapy on QOL. No carryover effect was observed in this crossover study. Each significant *P*-value is indicated in bold for both. Of the 15 QOL measurements addressed in Table 2, eight were considered significant during the first period, and 11 were considered significant during the crossover assessment. The three added QOL measurements included physical well-being (0.0034), pain (0.0379), and heart rate (0.0051). Items such as nausea, blood pressure (both diastolic and systolic), and overall QOL were not shown to be significant.

Table 3 presents the percentage of patients reporting a clinically meaningful improvement of at least ½ SD. Items such as heart rate (0.0328), physical well-being (0.0001), emotional well-being (0.0001), spiritual well-being (0.0001), intellectual well-being (0.0008), overall well-being (0.0001), anxiety (0.0056), sadness (0.0136), and relaxation (0.0001) were considered significant, even at the ½ SD level (illustrated in Table 3 by bolding).

The treatment effect sizes are illustrated in Table 4 showing the changes in means and SDs for each endpoint in the first 24 hours. The difference in the treatment effects also is illustrated in Figs. 2 and 3 and Table 5. Fig. 2 summarizes the differences in treatment by assessing the various QOL-related endpoints for both the music and standard groups in the first period. Fig. 3 illustrates the effect sizes of the clinical outcome measures on heart rate, blood pressure, heart rate, and respiration rate. Again, this figure is assessing the music treatment effects from the two original first periods. Table 5 illustrates the end-of-study survey, which asked if the patients felt the harp improved their well-being. In this case, of the 92 patients, 72% felt there was an improvement.

Discussion

The purpose of this study was to obtain preliminary evidence in a classical scientific design to determine the effects of therapeutic music on the clinical (ANS) outcomes of hospitalized patients using QOL measures. The study was designed to detect at least moderate effect sizes, as it is thought that any smaller effect could be explained by numerous concomitant influences and, therefore, may not be worthy of further study. The magnitude of effect of the results

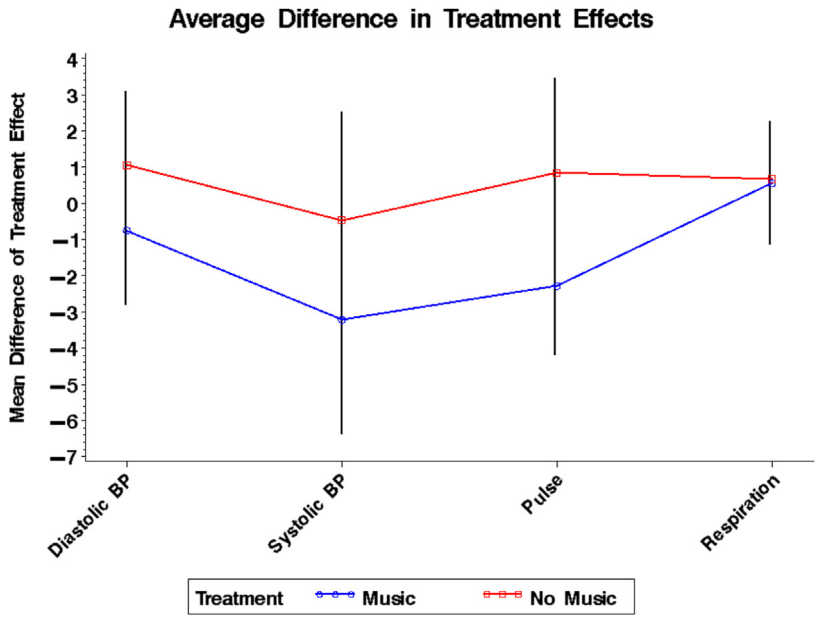

Fig. 3. The average difference in treatment effects continued when comparing the addition of music vs. standard care only. Like Fig. 2, this figure addresses the average treatment effect differences between only standard care and harp therapy in addition to standard care. Here, however the mean differences with 95% confidence intervals are addressed through blood pressure readings (both systolic and diastolic), pulse and respiration reads.

is striking and incontrovertible. The intervention had profound impact on virtually every aspect of patient QOL examined. The impact on physiologic variables was restricted to heart rate. Nonetheless, this study provides ample evidence that this line of intervention presents a promising avenue for improving disease-related QOL endpoints.

Some key questions remain. Is the effect seen in this study a result of the impact of the individual harp therapist or the music itself? Because the therapeutic music was conducted to meet the individual's preferences via the harpist asking individualized questions, could this alone have had impact on the patient's outcomes? In addition, would additional harp treatments per patient have increased or sustained the effects? These questions are worthy of exploration in future studies. This study was not designed to answer these questions. Instead, this study was designed as a proof of principle investigation into whether harp music delivered in a standardized manner could elicit measurable improvements in patient-reported QOL. The effects observed were of a size that is indicative of a substantial impact on patient QOL. The need for further follow-up is indicated.

Another aspect of the study was to test the feasibility of delivering such an intervention in a clinical setting in an effective but unobtrusive manner. The study protocol was designed to efficiently dovetail with clinical requirements of delivering nursing and medical care; for example, all research assistants were nurses who consulted with charge and duty nurses as to the best time for delivery of the harp intervention. Nursing and medical staff were informed before the start of the study, through written and verbal information, as to the meaning, purpose, and requirements of the study, in an attempt to minimize conflicts. The therapeutic harpist had previous advanced degree training and experience in working with hospitalized patients and experience in integrating the use of the harp in direct patient and hospital care, which facilitated arrangements with staff, patients, and family members.

Table 2, which addressed the rank sum test change in values from before and after the intervention, illustrates a positive correlation with Table 3, which indicated the ½ SD of improvement within patients. Of the 15 QOL measurements that are shown in both Tables 2 and 3, nine were identified as significant across both tables. Two others (fatigue and pain) were seen as significant only at the rank sum test. This correlation could suggest that the harp music has a significant effect on the nine QOL measurements that were identified across both tables. This finding could help future attempts to improve anxiety and, therefore, overall well-being, QOL, and other patient outcomes.

This study had some limitations. The lack of blinding raises the question of the degree to which the efficacious results were a function of a placebo effect. One can answer this in two ways. First, the changes in patient scores were of such a profound nature that it is unlikely that the total effect resulted strictly

from a perceived placebo effect. Second, patients served as their own controls and as the ultimate arbiters as to whether they felt the therapeutic harpist intervention was efficacious. As the overwhelming conclusion of the patients was that the intervention did impact a wide array of clinical endpoints, it is hard to argue that the patients were uniformly incorrect in their perceptions.

Another limitation is that a single individual delivered the therapeutic harp intervention. The extent to which the intervention's efficacy is a function of that individual rather than a generalizable effect of therapeutic harp is debatable. Specifically, the intervention was based on the preferences and expertise of this individual. It is possible that other therapeutic harpists would have approached the delivery of the intervention in a different manner. Nonetheless, the intervention was based on general principles of therapeutic music and, specifically, therapeutic harp music. Therefore, the variability among harpists is not likely to be so large as to jeopardize the demonstrated efficacy of the intervention. This can only be tested through further research.

The above limitations notwithstanding the results of the study were profound and consistent in demonstrating the potential efficacy of a therapeutic harp intervention to ameliorate a wide variety of psychosocial endpoints among hospitalized patients and to improve patient QOL. This study demonstrates that complementary therapies can be assessed in a replicable scientific framework with an equal degree of rigor and scrutiny as any other potentially ameliorative therapy. Future research will further explore the precise mechanisms of action within the components of this complex intervention and investigate alternative modes of administration.

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References

1. Hillecke T, Nickel A, Bolay HV. Scientific perspectives on music therapy. Ann N Y Acad Sci 2005;1060:271–282.

2. Watkins G. Music therapy: proposed physiological mechanisms and clinical implications. Clin Nurse Spec 1997;11:43–50.

3. Ellis R, Koenig J, Thayer J. Getting to the heart: autonomic nervous system function in the context of evidence-based music therapy. Music Med 2012;4:90–99.

4. Huron D. Two challenges in cognitive musicology. Top Cogn Sci 2012;4:678–684.

5. Tan X, Yowler CJ, Super DM, Fratianne RB. The interplay of preference, familiarity and psychophysical properties in defining relaxation music. J Music Ther 2012;49:150–179.

6. Bradt J. Randomized controlled trials in music therapy: guidelines for design and implementation. J Music Ther 2012;49:120–149.

7. Levitin DJ. Neural correlates of musical behaviors: a brief overview. Music Ther Perspect 2013;31:15–24.

8. Engwall M, Duppils G. Music as a nursing intervention for postoperative pain: a systematic review. J Perianesth Nurs 2009;24:370–383.

9. Wipple B, Glynn N. Quantifications of the effects of listening to music as a noninvasive method of pain control. Sch Inq Nurs Pract 1992;6:42–59.

10. White J. Music therapy: an intervention to reduce anxiety in the myocardial infarction patient. Clin Nurse Spec 1992;6:58–63.

11. Lin MF, Hsieh YJ, Hsu YY, Fetzer S, Hsu MC. A randomized controlled trial of the effect of music therapy and verbal relaxation on chemotherapy-induced anxiety. J Clin Nurs 2011;20:988–999.

12. Beck S. The therapeutic use of music for cancer-related pain. Oncol Nurs Forum 1991;18:1327–1337.

13. Guzetta CE. Music therapy: hearing the melody of the soul. In: Dossey BM, Keegan L, Guzzetta CE, Kolkmeier LG, eds. Holistic nursing, A handbook for practice, 2nd ed Gaithersburg, MD: Aspen Publishers, Inc., 1995:669–698.

14. Leeds J. The power of sound. Rochester, VT: Healing Arts Press, 2001.

15. Chlan L. Effectiveness of a music therapy intervention on relaxation and anxiety for patients receiving ventilatory assistance. Heart Lung 1998;27:169–176.

16. Aragon D, Farris C, Byers JF. The effects of harp music in vascular and thoracic surgical patients. Altern Ther Health Med 2002;8:52–54. 56-60.

17. Brundage M, Blazeby J, Revicki D, et al. Patient-reported outcomes in randomized clinical trials: development of ISOQOL reporting standards. Qual Life Res 2013;22:1161–1175.

18. Sloan JA, Zhao X, Novotny PJ, et al. Relationship between deficits in overall quality of life and non–small-cell lung cancer survival. J Clin Oncol 2012;30:1498–1504.

19. Senn S. Cross-over trials in clinical research. New York: John Wiley & Sons Ltd, 1993.

20. Zanini CR, Jardim PC, Salgado CM, et al. Music therapy effects on the quality of life and the blood pressure of hypertensive patients. Arq Bras Cardiol 2009;93:534–540.

21. Sloan JA, Novotny P, Loprinzi CL, Ghosh M. Graphical and analytical tools for two-period crossover clinical trials. SUGI Proceedings 1997;22:1312–1317.

22. Norman GR, Sloan JA, Wyrwich KW. Interpretation of changes in health related QOL. The remarkable universality of a half standard deviation. Med Care 2003;42:582–592.

23. Fairclough DL. Design and analysis of QOL studies in clinical trials. Boca Raton, FL: Chapman and Hall/CRC Press, 2002.

24. Huntington JL, Dueck A. Handling missing data. Curr Probl Cancer 2005;29:317–325.

25. Sloan JA, Vargas-Chanes D, Kamath CC, et al. Detecting worms, ducks, and elephants: a simple approach for defining clinically relevant effects in quality-of-life measures. JCIM 2003;1:41–47.

26. Sloan JA, Novotny PJ, Loprinzi CL, Nair S. Graphical and analytical tools for the analysis of two-period crossover clinical trials. Proceedings of the Twenty-Second Annual SASA Users Group International Conference, San Diego, CA, March 16-19. Cary, NC: SAS Institute Inc, 1997, Paper 280:1312–1317.

27. Mandrekar J, Sargent DJ, Novotny PJ, Sloan JA. A general gibbs sampling algorithm for analyzing linear models using the SAS system. Proceedings of the 24th Annual SAS Users Group International Conference. 1999;24:1540–1545.