The Anxiety- and Pain-Reducing Effects of Music Interventions: A Systematic Review

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ABSTRACT

MUSICAL INTERVENTIONS have been used in health care settings to reduce patient pain, anxiety, and stress, although the exact mechanism of these therapies is not well understood.

THIS ARTICLE PROVIDES A SYSTEMATIC review of 42 randomized controlled trials of the effects of music interventions in perioperative settings.

MUSIC INTERVENTION HAD POSITIVE effects on reducing patients' anxiety and pain in approximately half of the reviewed studies.

FURTHER RESEARCH into music therapy is warranted in light of the low cost of implementation and the potential ability of music to reduce perioperative patient distress. ***AORN J*** **87 (April 2008) 780-807. © AORN, Inc, 2008.**

Nurses face many challenges as they care for the needs of hospitalized patients, and they often have to prioritize physical care over the patient's emotional, spiritual, and psychological needs. Meeting these additional needs is a challenge. In clinical practice, music intervention can be a tool to support these needs by creating an environment that stimulates and maintains relaxation, well-being, and comfort. Music can be used as a self-management technique to reduce or control distress.[1] This article provides a systematic review of recent studies describing the clinical effects of music interventions for hospitalized patients in perioperative settings.

The History of Music in Health Care

Music has been used since ancient times to influence human health.[1] Archaeological findings show that primitive man used music as a way to "appease the gods."[2] In the sixth century, the Greek philosopher Pythagoras, who is considered the founder of music therapy and geometry, believed that music greatly contributed to health. Pythagoras prescribed music and a specific diet to restore and maintain the harmony of the body and soul.[3]

In the mid 1800s, Florence Nightingale recognized the power of music in hospital wards to aid in the healing process for soldiers injured in the Crimean War. Nightingale also noted the effects of different types of music. She observed that wind instrument pieces with continuous sound or air generally had a beneficial effect on patients. She also observed that instruments that do not produce continuous sounds had the opposite effect. Nightingale believed it was the responsibility of nurses to control the patient's environment in order for healing to take place.[1,3-5]

After the invention of the phonograph in the late 1800s, recorded music could be used in the hospital setting. The most extensive account of music in general hospitals appeared during the first half of the 1900s when health care practitioners used music in conjunction with anesthesia and analgesia.[6] In 1914, Kane was the first person to provide intraoperative music to distract patients from the "horror of surgery."[7(p1829)]

In 1926, Ilsen established the National Association for Music in Hospitals. Ilsen, a nurse, advocated for the implementation of specific musical prescriptions or treatment regimes. She identified rhythm as the basic therapeutic element in music.[8]

In 1949, a group of surgeons studied the use of music in conjunction with psychosomatic factors in physical illness. They performed a series of procedures

and observed that music had a calming effect on patients who were normally tense and nervous and for whom routine medications did not work.[9]

The Therapeutic Effects of Music

Various complex theories, hypotheses, and assumptions have been proposed regarding how music works in the health care setting. In 2006, Sacks[10] indicated that the power of music scarcely has been examined, even though significant advances had been made in the preceding 20 years. Sacks believed that the power of music goes to the heart of being human.[10]

In 1990, Thaut[11] proposed that music stimuli have biological effects on human behavior by engaging specific brain functions involved in memory, learning, and multiple motivational and emotional states. The effects of music are seen in the right hemisphere of the brain; however, the left hemisphere may play a major role in the analytical aspects of cerebral interpretation of the music. Auditory perception of music occurs in the auditory center of the temporal lobe of the brain, which then signals the thalamus, midbrain, pons, amygdala, medulla, and hypothalamus.[11]

The commonly accepted theory explaining the pain-, anxiety-, and stress-reducing effects of music is that music acts as a distracter, focusing the patient's attention away from negative stimuli to something pleasant and encouraging. Music occupies the patient's mind with something familiar and soothing, which allows the patient to escape into his or her "own world." Additionally, patients can focus their awareness on the music to aid relaxation.[3,12-14]

It is important to provide perioperative nurses and managers with evidence that these interventions help reduce patients' experience of unpleasant symptoms and discomfort. In perioperative settings, patients often are in a transitional zone between consciousness and sleep. Many senses are impaired, but the patient's sense of hearing still functions.[1]

This systematic review of the literature, therefore, was conducted to identify randomized controlled trials (RCTs) that have assessed the effect of music interventions on perioperative patients' pain and anxiety. The definition of an RCT is a study in which patients are assigned to treatment groups or a control group based on a random or quasi-random method (eg, using random days, weeks, numbers).

Search Strategy Methods

A search of research articles published between January 1995 and January 2007 was performed on the Allied and Complementary Medicine Database (AMED), the Cumulative Index to Nursing and Allied Health Literature (CINAHL), and Medline. Only articles written in English containing the following search terms were included:

- music,
- therapy,
- preoperative,
- intraoperative,
- postoperative,
- perioperative,
- surgery,
- anaesthesia,
- anesthesia,
- pain, and
- anxiety.

The search was conducted using terms both separately and in combination with each other.

The search returned a total of 173 articles, distributed as follows:

- 13 from AMED,
- 77 from CINAHL, and
- 83 from Medline.

After removing duplicate articles, the researcher reviewed a total of 69 articles, screening them for eligibility. Thirteen of the 69 articles were excluded because they reported the use of live music performed by a music therapist; music was used only in combination with other nonpharmacological methods (eg, guided imagery, massage); or use of sound instead of music (eg, hemispheric, binaural sound). Eighteen articles were excluded because of nonrandomization, lack of clarity in the methods or results, or because inclusion and exclusion criteria were not reported. Five articles were excluded because the study results were reported in more than one article.

In addition, a manual search was performed using the reference lists from the retrieved articles. An additional nine studies were found through this search, a manual search of relevant journals, and the researcher's knowledge

of the literature and research in this field.

Only RCTs written in English were included. Additionally, the patient population was limited to adult patients (ie, older than 17 years); and music interventions were limited to those performed preoperatively, intraoperatively, and/or postoperatively. Outcome measures of the included studies were pain, anxiety, and stress indicators. The music interventions in the reviewed articles consisted of recorded music. This literature search identified 42 relevant RCTs that met the inclusion criteria (Table 1).

Quality Assessment

The author used a 3-point scale to assess five main features of the methodological quality of the 42 studies. These features included

- outcome measure questionnaires, rated
  - 2 if validity and reliability has been demonstrated in 90% or more of the outcome measures,
  - 1 if validity and reliability has been demonstrated in 89% or less of the outcome measures, or
  - 0 if validity and reliability was not demonstrated;
- blinding, rated
  - 2 for double-blind studies,
  - 1 for single-blind studies, or
  - 0 for no blinding;
- concealment of allocation at enrollment, rated
  - 2 for truly randomized allocation,
  - 1 for semisecure randomization, or
  - 0 for nonsecure randomization or unclearly demonstrated randomization;
- completeness of follow up, rated
  - 2 for 100% follow up or intent-to-treat analysis,
  - 1 for 80% to 90% follow up, or
  - 0 for follow up less than 80% or when information was unclear; and
- sample size calculation, rated
  - 2 if a sample size calculation was performed or
  - 0 if a sample size calculation was not performed.

These criteria for quality assessment were taken from Rubin and Hotopf's systematic review exploring postoperative fatigue;[15] however, the researcher added the criteria "sample size calculation." The calculation of sample size helps maximize the chances of detecting a statistically and clinically significant difference between the interventions when a difference really exists.[16] Using this assessment tool, a total quality score was assigned to each article. Ratings could range from 0 (ie, the worst quality) to 10 (ie, the best quality).

For a meta-analysis, the intervention and the dose of the intervention must be constant. For the studies included in this review, the types of music used differed; the duration of listening time differed (ie, the dose); and the patients' care differed. A meta-analysis, therefore, was not performed. Thus, the studies were assessed for the quality of their methodology, and they were analyzed according to outcome measures.

Results

A total of 42 RCTs were assessed. They varied in patient demographics and procedural type, the timing and type of musical intervention used, and the quality measurement assigned to the RCT by the researcher conducting this review.

Baseline characteristics. The 42 RCTs that were reviewed included 3,936 patients. The number of patients in these studies ranged from nine to 500. The mean age of the participants ranged from 34 to 76 years. In 33 of the studies, both men and women were included. In one study, only men were included, and in five studies only women were included. Three studies did not report the gender of the participants.

Patients in all the studies underwent elective surgery. The types of surgery included gynecological; abdominal; ear, nose, and throat; cardiac; urologic; ophthalmologic; orthopedic; and breast biopsy. Some studies included combinations of different types of surgery (eg, major abdominal, outpatient). Other studies were more precise in their inclusion criteria, with all included patients having the same type of surgery (eg, hysterectomy, septorhinoplasty, inguinal hernia repair, open-heart surgery, transurethral resection of the prostate, varicectomy, lithotripsy, cataract surgery, lumbar disk surgery).

TABLE 1
Randomized Control Trials That Met Inclusion Criteria

Study	Quality score*	N	Ages or mean age	Type of surgery	Intervention period
Allen et al[1] 2001 USA	4	40 Male: 10 Female: 30	76	Ambulatory ophthalmic	Preoperative, intraoperative, postoperative
Augustin & Hains[2] 1996 USA	4	42 Male: 25 Female: 17	47	Ambulatory	Preoperative
Ayoub et al[3] 2005 USA	8	90 Male: 77 Female: 13	55	Urological with spinal anesthesia	Intraoperative
Barnason et al[4] 1995 USA	8	96 Male: 65 Female: 31	67	Coronary artery bypass graft (CABG)	Postoperative day two and three
Blankfield et al[5] 1995 USA	3	95 Male: 65 Female: 30	61	CABG	Intraoperative and twice daily postoperative
Broscious[6] 1999 USA	6	156 Male: 107 Female: 49	66	Open heart	Postoperative before chest tube removal
Cepeda et al[7] 1998 Columbia	8	193 Male: 95 Female: 98	41	Extracorporeal shock wave lithotripsy with alfentanil patient-controlled anesthesia	Intraoperative, preoperative, postoperative
Cooke et al[8] 2005 Australia	7	180 Male: 90 Female: 90	56	Day	Preoperative
Cruise et al[9] 1997 Canada	6	121 Male: 44 Female: 77	70	Cataract with retrobulbar block	Intraoperative
Gaberson[10] 1995 USA	4	46 Male: 19 Female: 27	47	Day, elective	Preoperative
Good[11] 1995 USA	3	84 Male: 25 Female: 59	46	Major abdominal	Postoperative days one and two

** The quality score was assigned by this review's author. The range is from 0 (lowest) to 10 (highest).*

TABLE 1
Randomized Control Trials That Met Inclusion Criteria (continued)

Type of music intervention	Delivery method	Music duration	Participant allocation per type of intervention
Self-selected from 22 provided types	Cassette player with headphones	Unspecified	Music = 20 Usual care = 20
Self-selected from classical, environmental, New Age, country/ western, easy listening	Cassette player with headphones	15 to 30 minutes	Music = 21 Usual care = 21
Self-selected	CD player with headphones	Throughout procedure	Music = 31 White noise = 31 OR noise = 28
Self-selected from five soothing types	Cassette player with headphones	30 minutes	Music = 33 Music video = 29 Rest period = 34
Specific New Age album, provided	Cassette player with headphones	Throughout procedure and twice daily	Music = 32 Music and suggestion = 34 Control = 29
Self-selected from 10 types	Cassette player with headphones	10 minutes	Music = 70 White noise = 36 Usual care = 50
Self-selected, unspecified type	Unspecified type of player with headphones	10 minutes pre- and postoperative and throughout procedure (mean: 40 minutes)	Music = 97 Control = 96
Self-selected from classical, jazz, country/ western, New Age, easy listening, other	CD player with headphones	30 minutes	Music = 60 Control = 60 Usual care = 60
Classical with nature sounds, provided	Cassette player with headphones	Throughout procedure	Music = 32 Suggestion = 30 White noise = 29 OR noise = 30
Slow, quiet instrumental, provided	Cassette player with headphones	20 minutes	Music = 16 Humor = 15 Usual care = 15
Self-selected from synthesizer, harp, piano, orchestral, or slow jazz	Cassette player with headphones	60 minutes	Music = 21 Relaxation = 21 Music and relaxation = 21 Rest in bed = 21

TABLE 1
Randomized Control Trials That Met Inclusion Criteria (continued)

Study	Quality score	N	Ages or mean age	Type of surgery	Intervention period
Good & Chin[12] 1998 USA and Taiwan	4	38 Male: 3 Female: 35	41	Major abdominal or gynecologic	Postoperative days one and two
Good et al[13] 1999 USA	5	500 Male: 87 Female: 413	45	Major abdominal or gynecologic	Postoperative days one and two
Haun et al[14] 2001 USA	5	20 Female: 20	38	Breast biopsy	Preoperative
Ikonomidou et al[15] 2004 Sweden	6	55 Female: 55	34	Gynecologic laparoscopy	Preoperative and post-operative
Kliempt et al[16] 1999 United Kingdom	4	76 Male: 33 Female: 43	46	General with anesthesia	Intraoperative
Koch et al[17] 1998 USA	4	34 (Phase I) Male: 29 Female: 5	54	Urologic with spinal anesthesia	Intraoperative
		43 (Phase II) Male: 27 Female: 16	54	Lithotripsy	Intraoperative
Kwekkeboom[18] 2003 USA	3	58 Male: 18 Female: 40	53	Noxious, cancer-related	Preoperative and intra-operative
Laurion & Fetzer[19] 2003 USA	2	84 Female: 84	35	Gynecologic laparoscopy	Preoperative, intraoperative, postoperative
Lee et al[20] 2004 Hong Kong	3	113 Male: 58 Female: 55	51	Noninvasive out-patient with local or regional anesthesia	Preoperative
Lepage et al[21] 2001 Canada	4	50 Male: 31 Female: 19	38	Ambulatory with spinal anesthesia	Intraoperative
Masuda et al[22] 2005 Japan	5	44 (gender not specified)	Not specified	Orthopedic	Postoperative

TABLE 1
Randomized Control Trials That Met Inclusion Criteria (continued)

Type of music intervention	Delivery method	Music duration	Participant allocation per type of intervention
Self-selected from synthesizer, harp, piano, orchestral, or slow jazz	Cassette player with headphones	15 minutes	Music = 16 Rest in bed = 22
Self-selected from synthesizer, harp, piano, orchestral, or slow jazz	Cassette player with headphones	15 minutes	Music = 130 Relaxation = 130 Music and relaxation = 120 Rest in bed = 120
Self-selected New Age	Cassette player with headphones	20 minutes	Music = 10 Sleep or chat with family member = 10
Pan flute, provided	CD player with headphones	30 minutes, both preoperatively and postoperatively	Music = 29 Control = 26
Classical, provided	Cassette player with headphones	Throughout procedure	Music = 25 Hemispheric sound = 25 Control = 26
Self-selected own favorite	CD player with headphones	Throughout procedure	Music = 19 Regular OR noise = 15
Self-selected own favorite	CD player with headphones	Throughout procedure	Music = 21 Regular OR noise = 22
Self-selected from variety offered by researcher	CD player with headphones	5 to 15 minutes preoperatively and throughout procedure	Music = 24 Distraction = 14 Rest = 20
Piano, provided	Cassette player with headphones	Unspecified	Music = 28 Guided imagery = 28 Usual care = 28
Self-selected from Eastern, Western, easy listening, Chinese pop	CD player with headphones	20 to 40 minutes	Music = 58 Relaxing activities = 55 (eg, reading, television)
Self-selected from pop, jazz, classical, New Age	CD player with headphones	Throughout procedure	Music = 25 Usual care = 25
Self-selected from classical or Japanese (gagaku, noh, or enka)	Compact disc (CD) player with headphones	20 minutes	Music = 22 Usual care = 22

TABLE 1

Randomized Control Trials That Met Inclusion Criteria (continued)

Study	Quality score	N	Ages or mean age	Type of surgery	Intervention period
McCaffrey & Locsin[23] 2006 USA	1	124 Male: 44 Female: 80	76	Hip and knee	Postoperative three days
McRee et al[24] 2003 USA	5	52 Male: 19 Female: 33	43	General surgery with general, spinal, regional, or local anesthesia	Preoperative
Miluk-Kolasa et al[25] 1996 Poland	4	100 Male: 72 Female: 28	20 to 60	Varicectomy or laryngological	Preoperative
Mok & Wong[26] 2003 Hong Kong	3	80 Male: 15 Female: 65	18 to 70	Minor with local anesthesia	Intraoperative
Nilsson et al[27] 2001 Sweden	9	89 Female: 89	51	Hysterectomy with general anesthesia	Intraoperative
Nilsson et al[28] 2003(a) Sweden	8	182 Male: 132 Female: 50	52	Inguinal hernia or varicose vein	Postoperative
Nilsson et al[29] 2003(b) Sweden	8	151 Male: 107 Female: 44	54	Inguinal hernia repair varicose vein, general anesthesia	Intraoperative or postoperative
Nilsson et al[30] 2005 Sweden	9	75 Male: 72 Female: 3	56	Inguinal hernia repair with general anesthesia	Intraoperative or postoperative
O'Neill[31] 2002 United Kingdom	4	60 (Gender not specified)	46	Orthopedic	Postoperative
Sendelbach et al[32] 2006 USA	2	86 Male: 60 Female: 26	63	CABG or heart valve replacement	Postoperative
Shertzer & Keck[33] 2001 USA	2	87 Male: 82 Female: 5	59	Elective	Postoperative
Szeto & Yung[34] 1999 Hong Kong	1	9 (Gender not specified)	58	Elective	Preoperative

TABLE 1

Randomized Control Trials That Met Inclusion Criteria (continued)

Type of music intervention	Delivery method	Music duration	Participant allocation per type of intervention
Lullaby and self selected from differing relaxing options	CD player, unspecified means of delivery	1 to 4 hours daily	Music = 62 Usual care = 62
Piano, provided	CD player with headphones	30 minutes	Music = 13 Music and massage = 13 Massage = 13 Usual care = 13
Self-selected, unspecified type	Cassette player with headphones	60 minutes	Music = 50 Left alone = 50
Self-selected from classical, popular, contemporary, Chinese	Cassette player with headphones	Throughout procedure	Music = 40 Usual care = 40
New Age, provided	Cassette player with headphones	Throughout procedure	Music = 30 Music and suggestions = 31 Control = 28
Soft classical, provided	Cassette player with headphones	Mean: 117 minutes	Music = 62 Music and suggestions = 57 Control = 63 (ie, no music)
New Age, provided	CD player with headphones	Throughout procedure or 60 minutes	Intraoperative music = 51 Postoperative music = 51 Control = 49
New Age, provided	CD player with headphones	Throughout procedure or 60 minutes	Intraoperative music = 25 Postoperative music = 25 Control = 25
Self-selected, own music or music provided by researcher	CD player with headphones	120 minutes	Music = 30 Usual care = 30
Self-selected from easy listening, classical, or jazz	Cassette player with headphones	20 minutes for three sessions	Music = 50 Rest in bed = 36
Mozart and ocean music, provided	Cassette player with loud speaker	60 minutes	Music = 46 Usual care = 41
Self-selected from slow rhythmic, either Chinese or Western	Not specified	20 minutes	Music = 6 Usual care = 3

TABLE 1
Randomized Control Trials That Met Inclusion Criteria (continued)

Study	Quality score	N	Ages or mean age	Type of surgery	Intervention period
Taylor et al[35] 1998 USA	7	61 Female: 61	39	Hysterectomy	Postoperative
Tse et al[36] 2005 China	2	57 Male: 33 Female: 24	40	Functional endoscopic sinus or tubinectomy	Postoperative
Twiss et al[37] 2006 USA	5	86 Male: 28 Female: 58	74	CABG or heart valve replacement	Intraoperative and postoperative
Voss et al[38] 2004 USA	7	61 Male: 39 Female: 22	63	Open heart	Postoperative day one
Wang et al[39] 2002 USA	7	93 Male: 56 Female: 37	43	Unspecified with general or regional anesthesia	Preoperative
Yilmaz et al[40] 2003 Turkey	4	98 Male: 61 Female: 37	40	Extracorporeal shock wave lithotripsy with local anesthesia	Intraoperative
Yung et al[41] 2002 China	4	30 Male: 30	68	Transurethral resection of the prostate	Preoperative
Zimmerman et al[42] 1996 USA	4	96 Male: 65 Female: 31	67	CABG	Postoperative for three days

1. Allen K, Golden LH, Izzo JL Jr, et al. Normalization of hypertensive responses during ambulatory surgical stress by perioperative music. Psychosom Med. *2001;63(3):487-492.*
2. Augustin P, Hains AA. Effect of music on ambulatory surgery patients' preoperative anxiety. AORN J. *1996;63(4):750-758.*
3. Ayoub CM, Rizk LB, Yaacoub CI, Gaal D, Kain ZN. Music and ambient operating room noise in patients undergoing spinal anesthesia. Anesth Analg. *2005;100(5):1316-1319.*
4. Barnason S, Zimmerman L, Nieveen J. The effects of music interventions on anxiety in the patient after coronary artery bypass grafting. Heart Lung. *1995;24(2):124-132.*
5. Blankfield RP, Zyzanski SJ, Flocke SA, Alemagno S, Scheurman K. Taped therapeutic suggestions and taped music as adjuncts in the care of coronary-artery-bypass patients. Am J Clin Hypn. *1995;37(3):32-42.*
6. Broscious SK. Music: an intervention for pain during chest tube removal after open heart surgery. Am J Crit Care. *1999;8(6):410-415.*
7. Cepeda MS, Diaz JE, Hernandez V, Daza E, Carr DB. Music does not reduce alfentanil requirement during patient-controlled analgesia (PCA) use in extracorporeal shock wave lithotripsy for renal stones. J Pain Symptom Manage. *1998;16(6):382-387.*

TABLE 1
Randomized Control Trials That Met Inclusion Criteria (continued)

Type of music intervention	Delivery method	Music duration	Participant allocation per type of intervention
Self-selected own relaxing music	Cassette player with headphones	Unspecified	Unspecified to music, control, and usual care
Self-selected from own music, Chinese, and Western	Cassette player with headphones	30 minutes for five sessions	Music = 27 Usual care = 30
Use of six customized music CDs	CD player with headphones	Unspecified	Music = 42 Usual care = 44
Self-selected from synthesizer, harp piano, orchestral or slow jazz	Cassette player with headphones	30 minutes	Music = 19 Rest = 21 Usual care = 21
Self-selected own favorite	CD player with headphones	30 minutes	Music = 48 Control = 45
Self-selected from provided relaxing, slow rhythm, sedative	Unspecified type of player with headphones	Throughout procedure	Music = 50 Control = 48
Self-selected from slow rhythmic, either Chinese or Western	Unspecified type of player with headphones	20 minutes	Music = 10 Nurse presence = 10 Usual care = 10
Self-selected, limited to country/western, instrumental, New Age	Cassette player with headphones	30 minutes	Music = 32 Music video = 32 Rest = 32

8. Cooke M, Chaboyer W, Schluter P, Hiratos M. The effect of music on preoperative anxiety in day surgery. J Adv Nurs. *2005;52(1):47-55.*
9. Cruise CJ, Chung F, Yogendran S, Little D. Music increases satisfaction in elderly outpatients undergoing cataract surgery. Can J Anaesth. *1997;44(1):43-48.*
10. Gaberson KB. The effect of humorous and musical distraction on preoperative anxiety. AORN J. *1995;62(5):784-791.*
11. Good M. A comparison of the effects of jaw relaxation and music on postoperative pain. Nurs Res. *1995;44(1):52-57.*
12. Good M, Chin CC. The effects of Western music on postoperative pain in Taiwan. Kaohsiung J Med Sci. *1998;14 (2):94-103.*
13. Good M, Stanton-Hicks M, Grass JA, et al. Relief of postoperative pain with jaw relaxation, music and their combination. Pain. *1999;81(1-2):163-172.*
14. Haun M, Mainous RO, Looney SW. Effect of music on anxiety of women awaiting breast biopsy. Behav Med. *2001;27(3):127-132.*
15. Ikonomidou E, Rehnström A, Naesh O. Effect of music on vital signs and postoperative pain. AORN J. *2004; 80(2):269-278.*
16. Kliempt P, Ruta D, Ogston S, Landeck A, Martay K. Hemispheric-synchronisation during anaesthesia: a

TABLE 1
Randomized Control Trials That Met Inclusion Criteria (continued)

double-blind randomised trial using audiotapes for intra-operative nociception control. Anaesthesia. *1999;54(8):769-773.*
17. Koch ME, Kain ZN, Ayoub C, Rosenbaum SH. The sedative and analgesic sparing effect of music. Anesthesiology. *1998;89(2):300-306.*
18. Kwekkeboom KL. Music versus distraction for procedural pain and anxiety in patients with cancer. Oncol Nurs Forum. *2003;30(3):433-440.*
19. Laurion S, Fetzer SJ. The effect of two nursing interventions on the postoperative outcomes of gynecologic laparoscopic patients. J Perianesth Nurs. *2003;18(4):254-261.*
20. Lee D, Henderson A, Shum D. The effect of music on preprocedure anxiety in Hong Kong Chinese day patients. J Clin Nurs. *2004;13(3):297-303.*
21. Lepage C, Drolet P, Girard M, Grenier Y, DeGagné R. Music decreases sedative requirements during spinal anesthesia. Anesth Analg. *2001;93(4):912-916.*
22. Masuda T, Miyamoto K, Shimizu K. Effects of music listening on elderly orthopaedic patients during postoperative bed rest. Nord J Music Ther. *2005;14(1):4-14.*
23. McCaffrey R, Locsin R. The effect of music on pain and acute confusion in older adults undergoing hip and knee surgery. Holist Nurs Pract. *2006;20(5):218-226.*
24. McRee LD, Noble S, Pasvogel A. Using massage and music therapy to improve postoperative outcomes. AORN J. *2003;78(3):433-447.*
25. Miluk-Kolasa B, Matejek M, Stupnicki R. The effects of music listening on changes in selected physiological parameters in adult pre-surgical patients. J Music Ther. *1996;33(3):208.*
26. Mok E, Wong KY. Effects of music on patient anxiety. AORN J. *2003;77(2):396-410.*
27. Nilsson U, Rawal N, Uneståhl LE, Zetterberg C, Unosson M. Improved recovery after music and therapeutic suggestions during general anaesthesia: a double-blind randomised controlled trial. Acta Anaesthesiol Scand. *2001; 45(7):812-817.*
28. Nilsson U, Rawal N, Enqvist B, Unosson M. Analgesia following music and therapeutic suggestions in the PACU in ambulatory surgery; a randomized controlled trial. Acta Anaesthesiol Scand. *2003;47(3):278-283.*
29. Nilsson U, Rawal N, Unosson M. A comparison of intra-operative or postoperative exposure to music—a controlled trial of the effects on postoperative pain. Anaesthesia. *2003;58(7):699-703.*
30. Nilsson U, Unosson M, Rawal N. Stress reduction and analgesia in patients exposed to calming music postoperatively: a randomized controlled trial. Eur J Anaesthesiol. *2005;22(2):96-102.*
31. O'Neill O. The efficacy of music therapy on patient recovery in the post-anaesthetic care unit. J Adv Perioper Care. *2002;1(1):19-26.*
32. Sendelbach SE, Halm MA, Doran KA, Miller EH, Gaillard P. Effects of music therapy on physiological and psychological outcomes for patients undergoing cardiac surgery. J Cardiovasc Nurs. *2006;21(3):194-200.*
33. Shertzer KE, Keck JF. Music and the PACU environment. J Perianesth Nurs. *2001;16(21):90-102.*
34. Szeto CK, Yung PM. Introducing a music programme to reduce preoperative anxiety. Br J Theatre Nurs. *1999; 9(10):455-459.*
35. Taylor LK, Kuttler KL, Parks TA, Milton D. The effect of music in the postanesthesia care unit on pain levels in women who have had abdominal hysterectomies. J Perianesth Nurs. *1998;13(2):88-94.*
36. Tse MM, Chan MF, Benzie IF. The effect of music therapy on postoperative pain, heart rate, systolic blood pressures and analgesic use following nasal surgery. J Pain Palliat Care Pharmacother. *2005;19(3):21-29.*
37. Twiss E, Seaver J, McCaffrey R. The effect of music listening on older adults undergoing cardiovascular surgery. Nurs Crit Care. *2006;11(5):224-231.*
38. Voss JA, Good M, Yates B, Baun MM, Thompson A, Hertzog M. Sedative music reduces anxiety and pain during chair rest after open-heart surgery. Pain. *2004;112(1-2):197-203.*
39. Wang SM, Kulkarni L, Dolev J, Kain ZN. Music and preoperative anxiety: a randomized, controlled study. Anesth Analg. *2002;94(6):1489-1494.*
40. Yilmaz E, Ozcan S, Basar M, Basar H, Batislam E, Ferhat M. Music decreases anxiety and provides sedation in extracorporeal shock wave lithotripsy. Urology. *2003;61(2):282-286.*
41. Yung PM, Chui-Kam S, French P, Chan TM. A controlled trial of music and pre-operative anxiety in Chinese men undergoing transurethral resection of the prostate. J Adv Nurs. *2002;39(4):352-359.*
42. Zimmerman L, Nieveen J, Barnason S, Schmaderer M. The effects of music interventions on postoperative pain and sleep in coronary artery bypass graft (CABG) patients. Sch Inq Nurs Pract. *1996;10(2):153-174.*

Intervention. The majority of the music interventions (n = 15) were performed postoperatively.[17-31] In 10 of the studies, interventions were performed preoperatively,[32-41] and in nine of the studies, interventions were performed intraoperatively.[42-49] Two studies compared intraoperative and postoperative interventions.[50,51] The remaining five studies were performed with a combination of interventions:

- preoperative, intraoperative, and postoperative;[52-54]
- preoperative and intraoperative;[55]
- preoperative and postoperative;[56] and
- intraoperative and postoperative.[57,58]

The type of music was soothing (ie, 60 to 80 beats per minute), and in the majority of the studies (n = 29), self-selected music was used. This included the patient's own favorite music or music chosen from a selected list of musical genres (eg, classical, New Age, jazz). In the other 15 studies, one specific genre of music was provided by the researchers. This included New Age,[48-51,58] classical,[24,26,43,44] slow instrumental,[34] piano,[37,54] and pan flute.[56]

The duration of preoperative or postoperative listening time lasted from five minutes to four hours. In the majority of the studies, the listening time lasted from 15 to 30 minutes.[17,20-22,27,29-35,37,39-41,56] Intraoperatively, music was used during the entire period, beginning at the start of the procedure.[42-51,58] Four of the studies did not report the duration of the listening time.[28,53,54,57] In only one study was the music played using loud speakers.[26] Two of the studies did not report whether headphones or loudspeakers were used.[23,39] All of the remaining studies (n = 39) used headphones to provide music to the patients.

Quality. No single included study was assessed to have the maximum quality score of 10 points. The total quality scores ranged from 1 to 9, with a mean score of 6. Two studies scored 9 points,[48,51] and five studies scored 8 points.[17,24,42,50,52] All seven of these studies were published between 1995 and 2005. In 11 of the reviewed studies (ie, 26%), the quality was insufficient, meaning that the quality assessment method used in this review scored the studies three points or less.[19,23,26,27,29,36,39,47,54,55,58] These studies were published between 1995 and 2006.

A majority of the included studies (n = 30) had demonstrated validity and reliability measures in 90% of their outcomes.[17-21,23-26, 28,30-36,38,40-43,46-48,50,51,55-57] In the studies that demonstrated less or no validity and reliability, the most common reason was that the studies did not report the validity and reliability of the equipment used to measure blood pressure, heart rate, and respiratory rate.

Nine of the studies[24,28,33,40, 43,49-52] were single blind—that is, all patients used headphones, and the patients in the control group listened to a blank tape. The patients, thus, were blinded to their group assignment. Two studies were double blind,[42,48] in that neither the patient nor the researcher knew the group assignment (ie, control group, music intervention). In these studies, the participants received the music intraoperatively while they were under general anesthesia. The remaining studies had no blinding, with the patients in the control groups receiving usual care or rest.

Only eight studies[17,24,44,45,48,50-52] reported truly random allocation. Semisecure allocation (eg, flipping a coin, drawing a slip of paper) was reported in five studies.[18,26,35,43,57] In the remaining 21 studies, the randomization method was not explicit or was nonsecure (eg, patients were assigned to groups on random days or weeks). One hundred percent of follow up or intention-to-treat analysis was reported in 22 of the studies.[17,25,28-33,35-38,40-43,46,49,51-54] Twelve studies reported 80% to 90% follow up,[18-21,24,44,45,48,50,55,56,58] and in the rest of the studies, there was 79% or less follow up or the information was unclear.[22,23,26,27,34,39,47,57] Sample size calculation was reported in 13 of the included studies.[17,18,24,28,30,34,40,42,48,50-52,56]

Outcome Measures

Various outcome measures were recorded in the articles reviewed. These included patient anxiety, pain, vital signs, and blood sample indicators (Table 2).

Anxiety. A total of 24 studies evaluated the effect of music on patient anxiety.[17,19,24,27,30,32-37,39-43,45-47,49-51,55,57] The most common tool used to measure anxiety was the State-Trait Anxiety Inventory (STAI), which was used in 19 of the 24 studies.[17,19,24,27,32,33,35-37,39-43,46,47,49,55,57] A numeric rating scale was used in three studies,[17,50,51] and a visual analog scale was used in four studies.[30,34,43,46] Perceived control over anxiety was

TABLE 2
Summary of Significance of Measurements in the Included Studies

Source	Year	Anxiety score	Sedative use	Pain score	Analgesic use
Allen et al[1]	2001				
Augustin & Hains[2]	1996	No			
Ayoub et al[3]	2005	No	Yes		
Barnason et al[4]	1995	No			
Blankfield et al[5]	1995				No
Broscious[6]	1999			No	
Cepeda et al[7]	1998			No	
Cooke et al[8]	2005	Yes			
Cruise et al[9]	1997	No			
Gaberson[10]	1995	No			
Good[11]	1995	No		No	No
Good & Chin[12]	1998			Yes	
Good et al[13]	1999			Yes	No
Haun et al[14]	2001	Yes			
Ikonomidou et al[15]	2004			No	Yes
Kliempt et al[16]	1999				Yes
Koch et al[17]	1998	No	Yes	No	Yes
Kwekkeboom[18]	2003	No		No	
Laurion & Fetzer[19]	2003			Yes	No
Lee et al[20]	2004	Yes			
Lepage et al[21]	2001	No	Yes		
Masuda et al[22]	2005			Yes	
McCaffrey & Locsin[23]	2006			Yes	Yes
McRee et al[24]	2003	No			No
Miluk-Kolasa et al[25]	1996				
Mok & Wong[26]	2003	Yes			
Nilsson et al[27]	2001			Yes	No
Nilsson et al[28]	2003(a)	No		Yes	No
Nilsson et al[29]	2003(b)	Yes		Yes	Yes
Nilsson et al[30]	2005	Yes		Yes	Yes
O'Neill[31]	2002				
Sendelbach et al[32]	2006	Yes		Yes	
Shertzer & Keck[33]	2001			No	
Szeto & Yung[34]	1999	Yes			
Taylor et al[35]	1998			No	No
Tse et al[36]	2005			Yes	
Twiss et al[37]	2006	Yes			
Voss et al[38]	2004	Yes		Yes	

TABLE 2
Summary of Significance of Measurements in the Included Studies (continued)

Blood Pressure	Heart rate	Respiratory rate	Blood levels	Other stress or pain indicators
Yes	Yes			
No	Yes	No		
No	No	No		
No	No	No		
No	No			
				Side effects/quality of analgesia: No
Yes				
No	No	Yes		
No	No	Yes		
No	No			
No	No	No		
No	No	No		
No	No			Skin temperature: No Blood flow: No
No	No		Prolactin: No Cortisol: No	
Yes	Yes		Glucose: Yes	Skin temperature: Yes Cardiac output: Yes
Yes	No			
	No			
			Cortisol: Yes Glucose: No Immunoglobulin A: No	
No	Yes	Yes		
No	No			
No	No			
Yes	Yes			

TABLE 2
Summary of Significance of Measurements in the Included Studies (continued)

Source	Year	Anxiety score	Sedative use	Pain score	Analgesic use
Wang et al[39]	2002	Yes			
Yilmaz et al[40]	2003	Yes		No	Yes
Yung et al[41]	2002	No			
Zimmerman et al[42]	1996			Yes	

1. Allen K, Golden LH, Izzo JL Jr, et al. Normalization of hypertensive responses during ambulatory surgical stress by perioperative music. Psychosom Med. *2001;63(3):487-492.*
2. Augustin P, Hains AA. Effect of music on ambulatory surgery patients' preoperative anxiety. AORN J. *1996;63 (4):750-758.*
3. Ayoub CM, Rizk LB, Yaacoub CI, Gaal D, Kain ZN. Music and ambient operating room noise in patients undergoing spinal anesthesia. Anesth Analg. *2005;100(5):1316-1319.*
4. Barnason S, Zimmerman L, Nieveen J. The effects of music interventions on anxiety in the patient after coronary artery bypass grafting. Heart Lung. *1995;24(2):124-132.*
5. Blankfield RP, Zyzanski SJ, Flocke SA, Alemagno S, Scheurman K. Taped therapeutic suggestions and taped music as adjuncts in the care of coronary-artery-bypass patients. Am J Clin Hypn. *1995;37(3):32-42.*
6. Broscious SK. Music: an intervention for pain during chest tube removal after open heart surgery. Am J Crit Care. *1999;8(6):410-415.*
7. Cepeda MS, Diaz JE, Hernandez V, Daza E, Carr DB. Music does not reduce alfentanil requirement during patient-controlled analgesia (PCA) use in extracorporeal shock wave lithotripsy for renal stones. J Pain Symptom Manage. *1998;16(6):382-387.*
8. Cooke M, Chaboyer W, Schluter P, Hiratos M. The effect of music on preoperative anxiety in day surgery. J Adv Nurs. *2005;52(1):47-55.*
9. Cruise CJ, Chung F, Yogendran S, Little D. Music increases satisfaction in elderly outpatients undergoing cataract surgery. Can J Anaesth. *1997;44(1):43-48.*
10. Gaberson KB. The effect of humorous and musical distraction on preoperative anxiety. AORN J. *1995; 62(5):784-791.*
11. Good M. A comparison of the effects of jaw relaxation and music on postoperative pain. Nurs Res. *1995;44(1):52-57.*
12. Good M, Chin CC. The effects of Western music on postoperative pain in Taiwan. Kaohsiung J Med Sci. *1998;14 (2):94-103.*
13. Good M, Stanton-Hicks M, Grass JA, et al. Relief of postoperative pain with jaw relaxation, music and their combination. Pain. *1999;81(1-2):163-172.*
14. Haun M, Mainous RO, Looney SW. Effect of music on anxiety of women awaiting breast biopsy. Behav Med. *2001;27(3):127-132.*
15. Ikonomidou E, Rehnström A, Naesh O. Effect of music on vital signs and postoperative pain. AORN J. *2004;80 (2):269-278.*
16. Kliempt P, Ruta D, Ogston S, Landeck A, Martay K. Hemispheric-synchronisation during anaesthesia: a double-blind randomised trial using audiotapes for intra-operative nociception control. Anaesthesia. *1999; 54(8):769-773.*
17. Koch ME, Kain ZN, Ayoub C, Rosenbaum SH. The sedative and analgesic sparing effect of music. Anesthesiology. *1998;89(2):300-306.*
18. Kwekkeboom KL. Music versus distraction for procedural pain and anxiety in patients with cancer. Oncol Nurs Forum. *2003;30(3):433-440.*
19. Laurion S, Fetzer SJ. The effect of two nursing interventions on the postoperative outcomes of gynecologic laparoscopic patients. J Perianesth Nurs. *2003;18(4):254-261.*
20. Lee D, Henderson A, Shum D. The effect of music on preprocedure anxiety in Hong Kong Chinese day patients. J Clin Nurs. *2004;13(3):297-303.*
21. Lepage C, Drolet P, Girard M, Grenier Y, DeGagné R. Music decreases sedative requirements during spinal

TABLE 2
Summary of Significance of Measurements in the Included Studies (continued)

Blood Pressure	Heart rate	Respiratory rate	Blood levels	Other stress or pain indicators
No	No		Cortisol: No Catecholamine: No	Electrodermal activity: No
Yes	Yes			
No	No			

anesthesia. Anesth Analg. *2001;93(4):912-916.*
22. Masuda T, Miyamoto K, Shimizu K. Effects of music listening on elderly orthopaedic patients during post-operative bed rest. Nord J Music Ther. *2005;14(1):4-14.*
23. McCaffrey R, Locsin R. The effect of music on pain and acute confusion in older adults undergoing hip and knee surgery. Holist Nurs Pract. *2006;20(5):218-226.*
24. McRee LD, Noble S, Pasvogel A. Using massage and music therapy to improve postoperative outcomes. AORN J. *2003;78(3):433-447.*
25. Miluk-Kolasa B, Matejek M, Stupnicki R. The effects of music listening on changes in selected physiological parameters in adult pre-surgical patients. J Music Ther. *1996;33(3):208.*
26. Mok E, Wong KY. Effects of music on patient anxiety. AORN J. *2003;77(2):396-410.*
27. Nilsson U, Rawal N, Uneståhl LE, Zetterberg C, Unosson M. Improved recovery after music and therapeutic suggestions during general anaesthesia: a double-blind randomised controlled trial. Acta Anaesthesiol Scand. *2001;45 (7):812-817.*
28. Nilsson U, Rawal N, Enqvist B, Unosson M. Analgesia following music and therapeutic suggestions in the PACU in ambulatory surgery; a randomized controlled trial. Acta Anaesthesiol Scand. *2003;47(3):278-283.*
29. Nilsson U, Rawal N, Unosson M. A comparison of intra-operative or postoperative exposure to music—a controlled trial of the effects on postoperative pain. Anaesthesia. *2003;58(7):699-703.*
30. Nilsson U, Unosson M, Rawal N. Stress reduction and analgesia in patients exposed to calming music postoperatively: a randomized controlled trial. Eur J Anaesthesiol. *2005;22(2):96-102.*
31. O'Neill O. The efficacy of music therapy on patient recovery in the post-anaesthetic care unit. J Adv Perioper Care. *2002;1(1):19-26.*
32. Sendelbach SE, Halm MA, Doran KA, Miller EH, Gaillard P. Effects of music therapy on physiological and psychological outcomes for patients undergoing cardiac surgery. J Cardiovasc Nurs. *2006;21(3):194-200.*
33. Shertzer KE, Keck JF. Music and the PACU environment. J Perianesth Nurs. *2001;16(21):90-102.*
34. Szeto CK, Yung PM. Introducing a music programme to reduce preoperative anxiety. Br J Theatre Nurs. *1999;9 (10):455-459.*
35. Taylor LK, Kuttler KL, Parks TA, Milton D. The effect of music in the postanesthesia care unit on pain levels in women who have had abdominal hysterectomies. J Perianesth Nurs. *1998;13(2):88-94.*
36. Tse MM, Chan MF, Benzie IF. The effect of music therapy on postoperative pain, heart rate, systolic blood pressures and analgesic use following nasal surgery. J Pain Palliat Care Pharmacother. *2005;19(3):21-29.*
37. Twiss E, Seaver J, McCaffrey R. The effect of music listening on older adults undergoing cardiovascular surgery. Nurs Crit Care. *2006;11(5):224-231.*
38. Voss JA, Good M, Yates B, Baun MM, Thompson A, Hertzog M. Sedative music reduces anxiety and pain during chair rest after open-heart surgery. Pain. *2004;112(1-2):197-203.*
39. Wang SM, Kulkarni L, Dolev J, Kain ZN. Music and preoperative anxiety: a randomized, controlled study. Anesth Analg. *2002;94(6):1489-1494.*
40. Yilmaz E, Ozcan S, Basar M, Basar H, Batislam E, Ferhat M. Music decreases anxiety and provides sedation in extracorporeal shock wave lithotripsy. Urology. *2003;61(2):282-286.*
41. Yung PM, Chui-Kam S, French P, Chan TM. A controlled trial of music and pre-operative anxiety in Chinese men undergoing transurethral resection of the prostate. J Adv Nurs. *2002;39(4):352-359.*
42. Zimmerman L, Nieveen J, Barnason S, Schmaderer M. The effects of music interventions on postoperative pain and sleep in coronary artery bypass graft (CABG) patients. Sch Inq Nurs Pract. *1996;10(2):153-174.*

measured in one study,[55] and the Observer's Assessment of Alertness/Sedation was used in one study.[49]

In 12 of the 24 studies (50%), the music intervention significantly reduced anxiety scores.[27,30,33,35,36,39,40,47,49-51,57] Sedative use also was reported in three studies as a measurement of anxiety,[42,45,46] and in all three of these studies the sedative requirement was significantly less for patients who listened to music.

Pain. Twenty-two of the studies evaluated the effect of music on pain.[18-24,26-31,45,48-52,54-56] The visual analog scale, the most commonly used tool to measure pain, was used in 12 studies.[19-24,30,45,48,49,54,56] Other instruments were used to measure pain, including a numeric rating scale,[18,23,26-28,50-52,55] the McGill Pain Questionnaire,[31] and a verbal rating scale.[29,31] In 13 of the 22 trials (59%), music intervention was shown to have a significant pain-reducing effect, reflected by decreased pain scores.[20-24,27,29-31,48,50,51,54]

In 15 studies, analgesic use also was measured as an outcome of pain.[19,21,23,24,28,37,44,45,48-51,54,56,58] In seven of these studies (47%), the music intervention resulted in a significant decrease in the use of analgesics.[23,44,45,49-51,56] The quality of analgesia and side effects were assessed in one study[52] without any significant effects.

Vital signs. In 24 of the 42 studies (57%), the impact of music on a patient's vital signs was evaluated.[17,18,22,24,25,27,29,32,35-43,45-47,49,51,53,56] In 22 of these studies, the effect of music on blood pressure was measured,[17,18,22,25,27,29,32,35-43,45-47,49,53,56] and heart rate also was measured in 22 of the studies.[17,18,22,24,25,27,29,32,35-42,45-47,49,53,56] Eight studies measured patients' respiratory rate,[17,25,32,35,36,42,46,56] three studies assessed patients' oxygen saturation,[24,45,49] two studies evaluated patients' skin temperatures,[22,38] one study measured patients' blood flow,[22] one study measured cardiac output,[38] and one study measured patients' electrodermal activity as a vital sign outcome.[40] In six of the 22 studies (27%), the music intervention groups had significantly reduced heart rates,[25,29,32,38,47,53] and in six studies (27%), a significant decrease in blood pressure was reported.[29,38,43,47,49,53] A significant decrease in respiratory rate was reported in three of eight studies (38%).[25,35,56] Significantly improved oxygen saturation was noted in two of three studies,[24,49] and increased skin temperature and cardiac output was noted in one study.[38]

Four studies evaluated the effect of music on patient stress by measuring various blood indicators.[37,38,40,51] Cortisol was the most commonly measured stress indicator,[37,40,51] and one study reported a significant reduction in blood cortisol levels.[51] Other stress indicators included blood glucose,[38,51] prolactin,[37] and catecholamine.[40] One study reported a significant reduction in blood glucose.[38]

Discussion

Interventions to decrease preoperative anxiety include not only anxiolytic medications but also methods for distraction such as music.[59] It also has been reported that patients' postoperative recovery includes, among other things, regaining control over physical and psychological functions such as pain or anxiety.[60]

This systematic review shows that music intervention can have an effect on reducing patient anxiety and pain in the perioperative setting. This was demonstrated in approximately 50% of the outcomes in the studies included in this review. In quantitative measures, music intervention was found to reduce the use of sedatives and analgesics. Some minor but still significant effects of music interventions were documented in the reduction of heart rate, blood pressure, respiratory rate, and reduced blood cortisol levels. Bernadi et al[61] discovered that breathing frequency, heart rate, and blood pressure were increased when patients listened to music, and this increase was proportional to the tempo of the music. More interesting, however, was that two minutes of silence randomly interspersed between the different styles and tempos of music produced a decrease in respiratory rate, heart rate, and blood pressures below baseline levels.[61] Perhaps music functions more as a "driving input," and therefore, the effects of music with a slower tempo on a patient's vital signs are minor. Instead, music with a slower tempo might be more of a distracter from the patients' psychological and physiological experiences such as pain and anxiety.

In a study on experimentally induced cold pressor pain (ie, simulated pain created by immersing a patient's hand and forearm in ice-cold

water), the results indicated that the patients' preferred music distracted their attention from pain and helped provide control over it. While listening to music, the meaning of the negative sensation can be altered, and the patient gains a sense of autonomy and an ability to cope.[62] The positive effects of music intervention has been likened to patient-controlled analgesia,[13] and music could be called "audioanalgesia," "audioanxiolytic," or "audiorelaxation."

Types of music. The genre and the duration of the soothing music did not seem to influence the effectiveness of music intervention. These results are confirmed both by a review that explored the use of music and its effect on anxiety during short waiting periods[63] and a Cochrane review that explored the effects of music on pain.[64] Although patients' selection of the type of music has been advocated by some,[3,19-21] the Cochrane review found that the positive effect of music was similar in studies in which patients selected the type of music and those in which patients did not choose the type of music.[64] It appears that the tempo of the music is the most important factor, with slow and flowing music with 60 to 80 beats per minute having positive outcomes on relaxation and pain relief. It has been suggested in the literature that music used therapeutically should

- be nonlyrical,
- consist predominantly of low tones,
- comprise mostly strings with minimal brass or percussion,[1] and
- have a maximum volume level at 60 dB.[65]

Future Research

It should be noted that the music used in the investigations reviewed in this article was not developed or designed for the treatment of patients in the health care setting. Based on this review, it is not possible to determine whether the use of specially designed music would further improve the beneficial effects of the music intervention for these patients. Similarly, documentation concerning music's effects on patients related to the correct dosage (eg, volume, time period, choice of sound source) is very limited. Future research should evaluate the effects of specially composed music that is designed for this specific setting or for individual patients or patient groups. Likewise, the differences in the effect of music interventions related to patient gender, age, and ethnicity should be evaluated by future studies.

In the majority of the included studies, headphones were used. The use of headphones has been advocated along with an uninterrupted music sound source.[1] Music interventions delivered using loudspeakers suspended from the ceiling[14] was shown to block unpleasant environmental sounds and make patients feel more relaxed. A new challenge would be to study whether there is any benefit to patients of using an audio pillow to provide the music therapy. An audio pillow could provide an adjustable, patient-focused sound environment without shutting out the external world. It also would enable patients to rest in any position without the inconvenience of wearing headphones. It should be noted that the application of the present knowledge related to the use of music interventions in the health care setting hinges on an effective implementation strategy in practical patient care.

Limitations

For this review, only articles published in English were included. This may have created some bias concerning the conclusions (ie, a language bias), as some music intervention research has been published in other languages. Another potential bias of this review is that

Recommendations for Music Interventions in Clinical Practice

- Slow and flowing music, approximately 60 to 80 beats per minute
- Nonlyrical
- Maximum volume level at 60 dB
- Patient's own choice, with guidance
- Suitable equipment chosen for the specific situation
- A minimum duration of 30 minutes in length
- Measurement, follow up, and documentation of the effects

some research has not been published because of nonsignificant results (ie, a publication bias).[16]

In 11 of the 42 reviewed studies, the quality of the study was insufficient (ie, the study scored 3 points or less on the quality assessment scale). Some concerns included that there was no sample size calculation, the description of the random assignment or study dropouts was not explicit, or a semisecure randomization or no blinding was used. Some of the studies used nonvalidated questionnaires to assess the effect of the music intervention. Others did not report the validity and reliability of the equipment used to measure vital signs (eg, cardiovascular monitoring, standard practice). In a review of music interventions during short-term waiting periods before surgery, Cooke et al[63] came to the conclusion that some of the included studies (n = 12) had a number of methodological limitations. In the Cepada et al Cochrane review of music for pain relief,[64] half of the included studies were of low quality. The quality appraisal used by Cepada et al was similar to the one used in this study, although Cepada et al did not consider the validation of the questionnaires and sample size calculation.[64]

The Benefits of Reviewing RCTs

Using only RCTs helps protect against problems with selection bias and strengthens internal validity.[66] In studies that are not randomized, it has been shown that results can be overestimated by up to 40%, and in unblinded studies, the treatment effects may be overestimated by approximately 17%.[67] In 11 of the 42 studies included in this review, headphones were used in the control group. In nine of the 42, the design was single blind. In 31 of the studies, group selection of the patients was performed without any blinding.

When using RCT to evaluate the effectiveness of an intervention, it is important to move beyond the research design and evaluate the intervention in terms of three specific dimensions: whether the intervention works, can be implemented, and fulfills the need of consumers.[68] The results of this review show that perioperative music intervention works and has multiple, desirable clinical effects, primarily in the reduction of pain, anxiety, and stress. It also has been suggested that

- music intervention is easy to implement,
- patients enjoy it,[1-4,12,14] and
- patients can use music as a self-management technique for distraction or escapism.[69]

In the review presented here, the quality assessment was adapted from Rubin and Hotopf[15] with the addition of the criterion "sample size calculation." Calculating the sample size helps maximize the chances of detecting a statistically and clinically significant difference between interventions when a difference really exists.[16,66] The Consolidated Standard of Reporting Trials (CONSORT), which documents a set of recommendations for the reporting of clinical trials, also identifies that the method for determining sample size should be detailed in publications.[70]

It is notable that there was no relationship between the year of publication and the determined quality level of the studies. Future RCTs on music must maintain high quality standards. This can be ensured by following the CONSORT statement, which includes a flow diagram that can be used to identify the appropriate number of participants

- eligible for the study;
- excluded from the study,
- randomized;
- analyzed;
- assigned, but who did not actually receive the intervention; and
- lost to follow-up.

This statement also recommends providing specific details about blinding.[70]

Implications For Nursing

The effect of music on pain and stress for surgical patients is not well understood. A number of methodological limitations are evident in the reviewed research. Further research and research of higher quality is needed on the ability of music to affect patients' perioperative pain, anxiety, and stress. It is recommended that elements of the CONSORT statement be included in any future research in this area.

It is important to provide information on evidence-based interventions to perioperative nurses and managers. In clinical practice, it

also is important to meet the needs of patients by incorporating effective methods to reduce patients' anxiety and discomfort. Music intervention may be a useful method to reduce patients' experiences of unpleasant symptoms and discomfort. During perioperative care, soothing and relaxing music can be used as audioanalgesia, audioanxiolytic, or audiorelaxation as an integral part of the multimodal regimen administered to patients. Providing music to patients is an inexpensive technique that does not require extra staff members or expensive equipment. Music intervention can help maximize efforts to promote patient comfort and relaxation as well as reduce or control perioperative patient distress. – AORN –

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REFERENCES

1. Nilsson U. *The Effect of Music and Music in Combination With Therapeutic Suggestions on Postoperative Recovery* [doctoral thesis]. Linköping, Sweden: Linköping University; 2003.
2. Henry LL. Music therapy: a nursing intervention for the control of pain and anxiety in the ICU: a review of the research literature. *Dimens Crit Care Nurs.* 1995;14(6):295-304.
3. White JM. Music as intervention: a notable endeavor to improve patient outcomes. *Nurs Clin North Am.* 2001;36(1):83-92.
4. McCaffrey R, Locsin RC. Music listening as a nursing intervention: a symphony of practice. *Holist Nurs Pract.* 2002;16(3):70-77.
5. Nightingale F. *Notes on Nursing: What It Is, and What It Is Not.* Comm ed. Philadelphia, PA: Lippincott; 1992.
6. Taylor DB. Music in general hospital treatment from 1900 to 1950. *J Music Ther.* 1981;18(2):62-73.
7. Kane E. The phonograph in the operating room. *JAMA.* 1914;62:1829-1830.
8. Ilsen IM. How music is used in hospitals. *Musician.* 1926;31:30.
9. Light GA, Haymond WV, Livingston HM, Willard J. Use of magnetic recorder silent music during operation. *Curr Res Anesth Analg.* 1949;28 (6):330-338.
10. Sacks O. The power of music. *Brain.* 2006;129 (Pt10):2528-2532.
11. Thaut MH. Neurophysical processes in music perception and their relevance in music therapy. In: Unkefer RF. *Music Therapy in the Treatment of Adults With Mental Disorders: Theoretical Bases and Clinical Interventions.* New York, NY: Schirmer Books; 1990:3-32.
12. White JM. State of the science of music interventions. Critical care and perioperative practice. *Crit Care Nurs Clin North Am.* 2000;12(2):219-225.
13. Beck SL. The therapeutic use of music for cancer-related pain. *Oncol Nurs Forum.* 1991;18(8):1327-1337.
14. Thorgaard P, Ertmann E, Hansen V, Noerregaard A, Hansen V, Spanggaard L. Designed sound and music environment in postanaesthesia care units—a multicentre study of patients and staff. *Intensive Crit Care Nurs.* 2005;21(4):220-225.
15. Rubin GJ, Hotopf M. Systematic review and meta-analysis of interventions for postoperative fatigue. *Br J Surg.* 2002;89(8):971-984.
16. Jadad AR. *Randomised Controlled Trials: A User's Guide.* London, England: BMJ Books; 1998.
17. Barnason S, Zimmerman L, Nieveen J. The effects of music interventions on anxiety in the patient after coronary artery bypass grafting. *Heart Lung.* 1995;24(2):124-132.
18. Broscious SK. Music: an intervention for pain during chest tube removal after open heart surgery. *Am J Crit Care.* 1999;8(6):410-415.
19. Good M. A comparison of the effects of jaw relaxation and music on postoperative pain. *Nurs Res.* 1995;44(1):52-57.
20. Good M, Chin CC. The effects of Western music on postoperative pain in Taiwan. *Kaohsiung J Med Sci.* 1998;14(2):94-103.
21. Good M, Stanton-Hicks M, Grass JA, et al. Relief of postoperative pain with jaw relaxation, music and their combination. *Pain.* 1999;81(1-2):163-172.
22. Masuda T, Miyamoto K, Shimizu K. Effects of music listening on elderly orthopaedic patients during postoperative bed rest. *Nord J Music Ther.* 2005; 14(1):4-14.
23. McCaffrey R, Locsin R. The effect of music on pain and acute confusion in older adults undergoing hip and knee surgery. *Holist Nurs Pract.* 2006; 20(5):218-226.
24. Nilsson U, Rawal N, Enqvist B, Unosson M. Analgesia following music and therapeutic suggestions in the PACU in ambulatory surgery; a randomized controlled trial. *Acta Anaesthesiol Scand.* 2003;47(3):278-283.

25. O'Neill O. The efficacy of music therapy on patient recovery in the post-anaesthetic care unit. *J Adv Perioper Care*. 2002;1(1):19-26.
26. Shertzer KE, Keck JF. Music and the PACU environment. *J Perianesth Nurs.* 2001;16(21):90-102.
27. Sendelbach SE, Halm MA, Doran KA, Miller EH, Gaillard P. Effects of music therapy on physiological and psychological outcomes for patients undergoing cardiac surgery. *J Cardiovasc Nurs*. 2006; 21(3):194-200.
28. Taylor LK, Kuttler KL, Parks TA, Milton D. The effect of music in the postanesthesia care unit on pain levels in women who have had abdominal hysterectomies. *J Perianesth Nurs.* 1998;13(2):88-94.
29. Tse MM, Chan MF, Benzie IF. The effect of music therapy on postoperative pain, heart rate, systolic blood pressures and analgesic use following nasal surgery. *J Pain Palliat Care Pharmacother.* 2005; 19(3):21-29.
30. Voss JA, Good M, Yates B, Baun MM, Thompson A, Hertzog M. Sedative music reduces anxiety and pain during chair rest after open-heart surgery. *Pain.* 2004;112(1-2):197-203.
31. Zimmerman L, Nieveen J, Barnason S, Schmaderer M. The effects of music interventions on postoperative pain and sleep in coronary artery bypass graft (CABG) patients. *Sch Inq Nurs Pract.* 1996; 10 (2):153-174.
32. Augustin P, Hains AA. Effect of music on ambulatory surgery patients' preoperative anxiety. *AORN J.* 1996;63(4):750-758.
33. Cooke M, Chaboyer W, Schluter P, Hiratos M. The effect of music on preoperative anxiety in day surgery. *J Adv Nurs.* 2005;52(1):47-55.
34. Gaberson KB. The effect of humorous and musical distraction on preoperative anxiety. *AORN J.* 1995;62(5):784-791.
35. Haun M, Mainous RO, Looney SW. Effect of music on anxiety of women awaiting breast biopsy. *Behav Med.* 2001;27(3):127-132.
36. Lee D, Henderson A, Shum D. The effect of music on preprocedure anxiety in Hong Kong Chinese day patients. *J Clin Nurs.* 2004;13(3):297-303.
37. McRee LD, Noble S, Pasvogel A. Using massage and music therapy to improve postoperative outcomes. *AORN J.* 2003;78(3):433-447.
38. Miluk-Kolasa B, Matejek M, Stupnicki R. The effects of music listening on changes in selected physiological parameters in adult pre-surgical patients. *J Music Ther.* 1996;33(3):208.
39. Szeto CK, Yung PM. Introducing a music programme to reduce preoperative anxiety. *Br J Theatre Nurs.* 1999;9(10):455-459.
40. Wang SM, Kulkarni L, Dolev J, Kain ZN. Music and preoperative anxiety: a randomized, controlled study. *Anesth Analg.* 2002;94(6):1489-1494.
41. Yung PM, Chui-Kam S, French P, Chan TM. A controlled trial of music and pre-operative anxiety in Chinese men undergoing transurethral resection of the prostate. *J Adv Nurs.* 2002;39(4):352-359.
42. Ayoub CM, Rizk LB, Yaacoub CI, Gaal D, Kain ZN. Music and ambient operating room noise in patients undergoing spinal anesthesia. *Anesth Analg.* 2005;100(5):1316-1319.
43. Cruise CJ, Chung F, Yogendran S, Little D. Music increases satisfaction in elderly outpatients undergoing cataract surgery. *Can J Anaesth.* 1997;44(1):43-48.
44. Kliempt P, Ruta D, Ogston S, Landeck A, Martay K. Hemispheric-synchronisation during anaesthesia: a double-blind randomised trial using audiotapes for intra-operative nociception control. *Anaesthesia.* 1999;54(8):769-773.
45. Koch ME, Kain ZN, Ayoub C, Rosenbaum SH. The sedative and analgesic sparing effect of music. *Anesthesiology.* 1998;89(2):300-306.
46. Lepage C, Drolet P, Girard M, Grenier Y, DeGagné R. Music decreases sedative requirements during spinal anesthesia. *Anesth Analg.* 2001;93(4):912-916.
47. Mok E, Wong KY. Effects of music on patient anxiety. *AORN J.* 2003;77(2):396-410.
48. Nilsson U, Rawal N, Uneståhl LE, Zetterberg C, Unosson M. Improved recovery after music and therapeutic suggestions during general anaesthesia: a double-blind randomised controlled trial. *Acta Anaesthesiol Scand.* 2001;45(7):812-817.
49. Yilmaz E, Ozcan S, Basar M, Basar H, Batislam E, Ferhat M. Music decreases anxiety and provides sedation in extracorporeal shock wave lithotripsy. *Urology.* 2003;61(2):282-286.
50. Nilsson U, Rawal N, Unosson M. A comparison of intra-operative or postoperative exposure to music—a controlled trial of the effects on postoperative pain. *Anaesthesia.* 2003;58(7):699-703.
51. Nilsson U, Unosson M, Rawal N. Stress reduction and analgesia in patients exposed to calming music postoperatively: a randomized controlled trial. *Eur J Anaesthesiol.* 2005;22(2):96-102.
52. Cepeda MS, Diaz JE, Hernandez V, Daza E, Carr DB. Music does not reduce alfentanil requirement during patient-controlled analgesia (PCA) use in extracorporeal shock wave lithotripsy for renal stones. *J Pain Symptom Manage.* 1998;16(6):382-387.
53. Allen K, Golden LH, Izzo JL Jr, et al. Normalization of hypertensive responses during ambulatory surgical stress by perioperative music. *Psychosom Med.* 2001;63(3):487-492.
54. Laurion S, Fetzer SJ. The effect of two nursing interventions on the postoperative outcomes of gynecologic laparoscopic patients. *J Perianesth Nurs.* 2003;18(4):254-261.
55. Kwekkeboom KL. Music versus distraction for procedural pain and anxiety in patients with cancer. *Oncol Nurs Forum.* 2003;30(3):433-440.
56. Ikonomidou E, Rehnström A, Naesh O. Effect of music on vital signs and postoperative pain. *AORN J.* 2004;80(2):269-278.
57. Twiss E, Seaver J, McCaffrey R. The effect of music listening on older adults undergoing cardiovascular surgery. *Nurs Crit Care.* 2006;11(5):224-231.

58. Blankfield RP, Zyzanski SJ, Flocke SA, Alemagno S, Scheurman K. Taped therapeutic suggestions and taped music as adjuncts in the care of coronary-artery-bypass patients. *Am J Clin Hypn.* 1995;37(3):32-42.
59. Mitchell M. Patient anxiety and modern elective surgery: a literature review. *J Clin Nurs.* 2003;12(6): 806-815.
60. Allvin R, Berg K, Idvall E, Nilsson U. Postoperative recovery: a concept analysis. *J Adv Nurs.* 2007; 57(5):552-558.
61. Bernardi L, Porta C, Sleight P. Cardiovascular, cerebrovascular, and respiratory changes induced by different types of music in musicians and nonmusicians: the importance of silence. *Heart.* 2006; 92(4):445-452.
62. Mitchell LA, MacDonald RA, Brodie EE. A comparison of the effects of preferred music, arithmetic and humour on cold pressor pain. *Eur J Pain.* 2006; 10(4):343-351.
63. Cooke M, Chaboyer W, Hiratos MA. Music and its effect on anxiety in short waiting periods: a critical appraisal. *J Clin Nurs.* 2005;14(2):145-155.
64. Cepeda MS, Carr DB, Lau J, Alvarez H. Music for pain relief. *Cochrane Database Syst Rev.* 2006;(2): CD004843.
65. Staum MJ, Brotons M. The effect of music amplitude on the relaxation response. *J Music Ther.* 2000;37(1):22-39.
66. Altman DG. *Practical Statistics for Medical Research*. London, England: Chapman and Hall; 1991.
67. Schulz KF, Chalmers I, Hayes RJ, Altman DG. Empirical evidence of bias. Dimensions of methodological quality associated with estimates of treatment effects in controlled trials. *JAMA.* 1995;273(5):408-412.
68. Evans D. Hierarchy of evidence: a framework for ranking evidence evaluating healthcare interventions. *J Clin Nurs.* 2003;12(1):77-84.
69. Nilsson U, Unosson M, Kihlgren M. Experience of postoperative recovery before discharge: patients' views. *J Adv Periop Care*. 2006;2(3):97-106.
70. Moher D, Schulz KF, Altman D. The CONSORT statement: revised recommendations for improving the quality of reports of parallel-group randomized trials. *JAMA.* 2001;285(15):1987-1991.

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Routine Adult Vaccinations Reduce Threat of Disease

Adults who do not get recommended vaccinations leave themselves vulnerable to significant illness and possibly even death, according to a January 23, 2008, news release from the National Foundation for Infectious Diseases, Bethesda, Maryland. Routine immunization of children in the United States has saved many lives and prevented disease, however, new data from a Centers for Disease Control and Prevention survey indicate that many adults are not taking advantage of advancements in adult disease prevention.

Immunization is recommended for adults to protect against chickenpox, diphtheria, hepatitis A and B, human papillomavirus/cervical cancer, influenza, measles, meningococcal disease, mumps, pertussis, pneumococcal disease, rubella, shingles, and tetanus. Deaths and illnesses associated with these diseases are largely avoidable with vaccination.

In another recent survey, only 3% to 18% of adults were able to identify adult-specific vaccinations. The only exception was the influenza vaccination, which was named by nearly half of the respondents. Half of those surveyed also stated that they are not concerned about whether they or another adult family member will contract a vaccine-preventable disease.

The adult vaccination issue represents a national public health crisis. The consequences have far reaching ramifications for individuals, families, and the country as a whole. Though challenges exist in increasing immunization rates and awareness, experts continue to urge the integration of adult vaccinations into routine care to save lives and reduce needless illness.

New data show unacceptably low adult immunization rates and that adults unaware of infectious disease threat [news release]. Washington, DC: National Foundation for Infectious Diseases; January 23, 2008.