

## Music for Pediatric Patients in Medical Settings: A Systematic Review of Randomized Controlled Trials

Lee, Jin Hyung\*

The aim of this study was to systematically review the latest clinical trials in music medicine and medical music therapy for pediatric patients. Thirteen databases were searched to obtain randomized controlled/crossover design studies published between the year 2000 and 2012 in English language. Out of 1012 articles retrieved in the initial search, fifteen studies were identified based on an exclusion criteria. Overall, selected articles involved children 1 month to 18 years, sample size of 11 to 150, and total participants of 987. Studies were classified and compared as music medicine or music therapy studies through a systematic synthesis assessing general characteristics, methodological quality, measured outcomes, types of interventions and the study results. Seven music medicine and eight music therapy studies measured seven dependent variables using thirty-six different measurement tools with a large heterogeneity in the selection, type, and method of music interventions. Evaluation of the methodological quality revealed that many studies did not provide a full report of the research method, and did not meet some or most methodological standards, such as randomization, allocation concealment, double or partial blinding, and intention to treat analysis. Although overall research results were positive if not significant, poor methodological quality and heterogeneity in design and intervention strategies raise the question of research bias and trustworthiness issues. The systematic review concluded that music may have a valuable clinical effect in addressing the physical and psychosocial needs of hospitalized children, although more rigorous, homogeneous and replicable studies are greatly needed.

*Keywords* : Music, Music Therapy, Pediatric, Hospital, Systematic review

---

\* Doctoral Student/Lecturer, Department of Music Therapy, Temple University, USA

## 소아환자를 위한 음악: 무작위 임상연구의 체계적인 문헌고찰

이진형\*

본 연구는 소아환자대상 최근의 음악치료 및 음악을 사용한 임상연구들에 대한 체계적인 문헌 고찰(Systematic Review)을 위해 실시되었다. 이를 위해 13개 데이터베이스를 이용하여 2000년부터 2012년 사이에 영어로 발표된 무작위 임상 및 교차설계 연구들을 자료로 수집하였고, 최초 검색되었던 1023개의 논문 중 선정 및 제외기준에 따라 영어문헌 15건을 선별하였다. 선별 결과 연구 대상자는 1개월에서 만 18세까지의 아동 및 청소년으로 11명에서 150명 까지 표본크기가 다양했으며 전체 연구 참여자는 987명으로 집계되었다. 선별된 연구들은 음악요법 및 음악치료 연구로 분류되어 전반적인 유형, 연구절차와 방법론, 임상접근법, 측정도구 및 연구결과에 대해 체계적으로 분석되었다. 총 7건의 음악요법과 8건의 음악치료로 분류된 연구들은 7개영역의 종속변수를 36종류의 측정도구를 사용하여 측정하였는데 음악의 임상적 사용에 있어 음악의 선택, 종류 및 임상접근방법에 큰 차이가 있음이 나타났다. 연구절차와 방법론의 분석 결과 다수의 연구들이 주요 연구절차에 대한 기술이 충분치 않고 특히 무작위배정(Randomization), 배정순서 은폐(Allocation Concealment), 이중 또는 부분은폐(double or partial blinding) 및 참여자 감소율 (Attrition Rate)과 같은 방법론적 표준에 미치지 못함이 도출되었다. 전반적인 연구결과가 통계적으로 유의하거나 긍정적 결과가 보고된 바 있으나, 연구 방법론적 문제들과 임상접근법들의 이질성으로 인해 그 결과가 편향에 의해 오염되거나 신뢰성에 문제가 있음을 확인할 수 있다. 그 결과 음악이 소아 환자들의 신체 및 사회·심리적 필요를 다루는 도구로 임상적 가치가 있음을 제안할 수는 있지만 이에 대한 과학적인 근거로서는 절차와 접근법이 보다 엄격하고 균일하여 추후 재현이 가능한 연구들이 다수 요구됨을 알 수 있다.

핵심어 : 음악, 음악치료, 아동, 병원, 체계적 문헌고찰

---

\* 미국 템플대학교 음악치료학과 박사과정생 및 강사 (jinlee@temple.edu)

## I . Introduction

Illness accompanies not only physical but also mental pain and distress. Although the reason for seeking medical care is to decrease the pain and distress that patients experience, a prolonged hospitalization and painful treatments often exacerbate the negative consequences. Due to lack of sufficient coping mechanisms, the negative side effects children encounter from hospitalization can be even more detrimental (Lepore, Miles, & Levy, 1997).

A number of studies have looked at the effect of music on decreasing physical and psychological risks for children undergoing medical treatments, and systematic reviews and meta-analyses performed in last ten years have identified the following problems with the literature (Dileo & Bradt, 2005; Klassen, Klassen, Liang, Tjosvold, & Hartling, 2008; Mrázová & Celec, 2010; Naylor, Kingsnorth, Lamont, McKeever, & Macarthur, 2011; Robb & Carpenter, 2009; Standley & Whipple, 2003) : 1. Music appears to have a positive effect on children undergoing medical treatments, however the amount of good quality evidence is limited; 2. Due to heterogeneity in current research methodologies and clinical interventions, research results in this area are often inconclusive, and their statistical power is weak. Substantial efforts are needed to promote homogeneity in research methods and clinical approaches; 3. The more rigorous research method in clinical trials known as randomized controlled trials (RCTs) is needed, and continued synthesis of these studies is recommended. Therefore, the current review was designed to: 1. Review systematically the latest RCTs in music medicine and medical music therapy for pediatric patients; 2 Identify the overall level of research quality of those studies through qualitative synthesis of data; 3. Identify gaps in current research topics, methodologies, outcomes and interventions, and to propose an agenda for future research.

## II. Methods

### 1. Procedure

#### 1) Search strategy

The author developed a search strategy by consulting a librarian and referring to previous systematic reviews and meta-analyses (Dileo & Bradt, 2005; Klassen et al., 2008; Mrázová &

Celec, 2010; Naylor et al., 2011; Standley & Whipple, 2003). During the week of September 24, 2012, the following scientific databases were searched: Austhealth, CAIRSS for Music, CINAHL, Clinical Trials Gov, Cochrane Library, Dissertation Abstracts International, Global Health, HealthStar, LILACS, MEDLINE, ProQuest Digital Dissertations, PsycINFO, PubMed, Science Citation Index, using the keywords music, music therapy AND (children, child, pediatric, paediatric, adolescent OR adolescence), AND (hospitalization, rehabilitation OR medical). This search was intended to target studies involving music as a clinical intervention for children with various medical needs. The search was limited to randomized controlled trials (RCTs), publications in English from January 1990 to August 2012, articles in peer-reviewed journals and published or unpublished doctoral dissertations.

## 2) Study selection

The author screened all retrieved articles to determine if the study: (1) investigated the effectiveness of music for children with medical needs, (2) involved subjects 1 month to 18 years in age reflecting the age ranges reported in most studies, (3) utilized a randomized controlled trial design, and (4) could be classified as either music medicine or music therapy. Definitions of these classifications are discussed in the following section. Studies that involved patients undergoing dental treatments were excluded because these are considered routine procedures, the environment is entirely different from most medical settings, and interventions had been limited to music medicine only. In addition, studies with sample size of ten or less were excluded due to the small sample sizes. Lastly, studies that utilized mixed clinical mediums such as music with art or dance were excluded because it is difficult to attribute the therapeutic effect exclusively to music. <Table 1> lists all removed studies with the reason for exclusion.

<Table 1> List of Excluded Studies and Reasons for Exclusion

First Author	Year	Reasons
Caprilli	2007	IV: Musicians performing music therapy
Fratianne	2001	Subjects: No upper age limit for subjects
Jeffs	2007	IV: Music intervention as one of many self-selected distractions
Kemper	2008	Design: Single case research design
Kim	2010	IV: Intervention included mothers singing, talking and praying
Madden	2010	IV: Music intervention with dance
Noguchi	2006	IV: Intervention of Musical Storybook
Robb	2003	Design: Descriptive case study design

Note. IV: Independent Variable

### 3) Data extraction and analysis

The data extraction form by Bradt, Magee, Dileo, Wheeler, & McGilloway (2010) was modified to extract data from selected articles. The form captured: (1) general information, (2) research design, (3) participant characteristics, (4) methodological quality, (5) outcome measures, (6) results, and (7) details about type and nature of music interventions. For comprehensive comparisons based on the type of practice, the reviewer classified studies with music interventions developed and administered by health professionals as ‘music medicine(MM)’ and categorized the studies with interventions devised and delivered by trained music therapists with proper credentials as ‘music therapy (MT).’ According to Dileo & Bradt (2005), music medicine is an intervention “involving pre-recorded music listening experiences administered by medical personnel (p. 5)” and “the therapeutic effects of music itself as an intervention (p. 9).” On the other hand, music therapy is an intervention “involving a relationship between client and therapist, a therapeutic process and a “live” music experience” (Dileo & Bradt, 2005, p. 9).

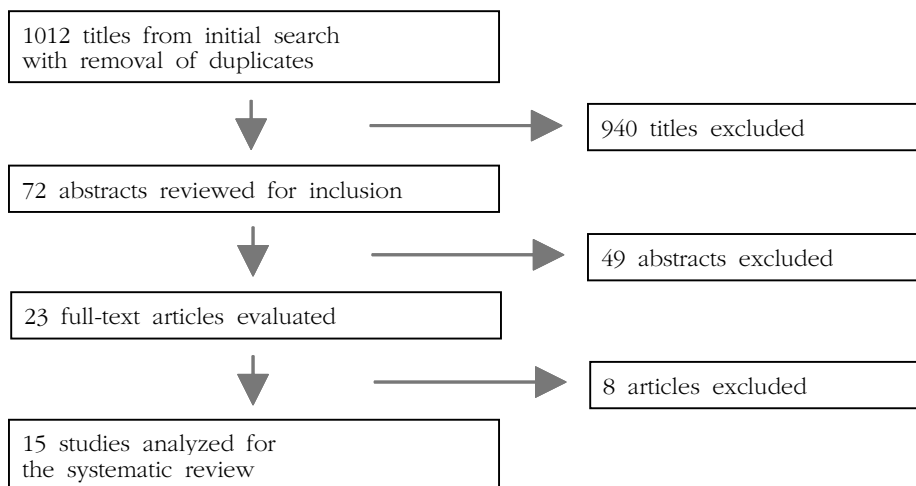
A number of tables were generated to compare and contrast different factors of the studies, and to present the findings in a qualitative manner. The data were further analyzed by types of intervention, medical specialty, outcomes measured by specialty areas, and major dependent variables. As Naylor et al.(2011) indicated, performing a meta-analysis on this topic seemed premature, given the number of studies available in each area of practice, the heterogeneity within each clinical approach, and the immediate need for informing future studies. Although the adequacy of statistical tests and reports was not analyzed, studies with one or more significant results in their quantitative report were marked with an asterisk (\*) to merely suggest a tendency within each context. It is important to note that no conclusion or generalization can be assumed based on this method of data presentation as no meta-analysis statistics were applied to determine pooled effect size and significance of the results.

## III. Results

### 1. Description of Reviewed Studies

The initial search yielded a total of 1012 journal articles and dissertations. From there, the author refined and narrowed the search by taking the following steps: 1) performing the

database search again with limits set at age < 18 and article type specified as randomized controlled trials; 2) assessing each article by title to sort out irrelevant papers; 3) reviewing abstracts for all relevant topics; 4) obtaining and examining full texts of articles for the final selection. It cannot, however, be ruled out that setting limits might have resulted in missing some published RCTs. Figure 1 illustrates the flow of study selection process.



〈Figure 1〉 Flow of study selection process.

The final sample consisted of ten 2-arm parallel, four 3-arm parallel and one crossover RCTs 〈Table 2〉. In regards to the intervention types, it included seven MM and eight MT studies. Of these fifteen articles, eight studies were conducted in the U.S., two were conducted in Australia, and five studies were carried out in different countries, specifically Brazil, Iceland, India, Israel and Vietnam. In surveying the region and characteristics of the publication venues, it was found that 11 articles were published in North America, two were from Europe, and one each was from Asia and South America. In addition, ten studies were published in medical journals, four in music therapy journals, and one in a psychology journal 〈Table 3〉. In terms of medical specialty, three or more studies were conducted in oncology, surgery and general medicine, whereas one or two were from burn care, emergency medicine, orthopedics, and pulmonology 〈Table 4〉. A comparison of the types of hospitalization showed an even number of studies conducted in inpatient and outpatient settings. Further exploration revealed that a majority of MM studies (n = 5 out of 7) took

place in an outpatient setting while a majority of MT studies (n = 5 out of 8) were carried out in an inpatient setting (Table 5).

The effect of music on health outcomes in medical settings has long been investigated by both medical professionals and music therapists. Many distinct differences exist depending on the profession of the interventionists, yet the name given to the intervention has been inconsistent as many medical professionals have titled their approach as ‘music therapy.’ In this review, however, only two out of the seven MM studies (Liu et al., 2007; Nguyen, Nilsson, Hellström, & Bengtson, 2010) contained the term ‘music therapy’ in the title of their reports, another two studies (Balan, Bavdekar, & Jadhav, 2009; Hatem, Lira, & Mattos, 2006) used the terms interchangeably in the report, and the last three articles (Kain, Wang, Mayes, Krivutza, & Teague, 2001; Kristjánsdóttir & Kristjánsdóttir, 2011; Press, Gidron, & Maimon, 2003) used the terms ‘music’ or ‘music medicine’ throughout their papers.

Overall, the studies included a total of 987 subjects, 620 in the MM and 367 in MT studies. Excluding three articles that did not provide gender distribution, 57% of the participants were male. Sample sizes ranged from 40 to 150 for MM studies, and 11 to 123 for MT studies. The median sample sizes were 79 and 28 respectively, and 69 for all studies. Participants ranged in age from 1 month to 18 years old, with a mean age of 8.1 (Table 7 & 8).

(Table 2) Types of RCT Design

RCT Design	MM	MT	Total
2 arm parallel	5(4*)	5(2*)	10(6*)
3 arm parallel	2*	2(1*)	4(3*)
Crossover	-	1*	1*

(Table 3) Publication Venue & Region

Publication Type	Region	MM	MT	Total
Medical Journal	Asia	1*	-	1*
	Europe	2(1*)	-	2(1*)
	North America	3*	3(2*)	6(5*)
	South America	1*	-	1*
Music Therapy Journal		-	3	3
Dissertation	North America	-	1*	1*
Psychology Journal		-	1*	1*

〈Table 4〉 Studies by Areas of Medical Specialty

Medical Specialty	MM	MT	Total
Oncology	1*	3(1*)	4(2*)
General	2*	1*	3*
Surgery	2*	1	3(2*)
Orthopedic	1*	1*	2*
Burn Center	-	1	1
Emergency Medicine	1	-	1
Pulmonology	-	1*	1*

〈Table 5〉 Types of Hospitalization

Hospitalization	MM	MT	Total
Outpatient	5(4*)	3(1*)	8(5*)
Inpatient	2*	5(3*)	7(5*)

Note. \* reported positive outcomes.

## 2. Quality Assessment:

The author appraised the quality of each study by examining the adequacy of the following methodological features: (1) randomization, (2) allocation concealment, (3) blinding of all researchers, (4) blinding of all assessors, and (5) intention to treat analysis. These quality features of RCT were extracted from the CONSORT Statement (Schulz, Altman, Moher, & CONSORT Group, 2010) which is a detailed guideline for 'Consolidated Standards of Reporting Trials.' Each category was first assessed as adequate, inadequate, or unknown. Upon completion of the appraisal, the reviewer scored each article from 0 to 5 according to the number of 'adequate' items. These scores are referred to as the quality appraisal scale (QAS) throughout the paper as an indicator of research rigor.

The methodological quality was generally poor for most studies; more so for MT studies than MM studies. Thirteen out of fifteen studies scored 2 or lower, including four studies that scored zero. Only the remaining two studies scored four or more (Kain et al., 2001; Nguyen et al., 2010). Four studies did not describe the method of randomization (marked with 'NC' in Table 6), another four randomized by clinic day or order of enrollment which is considered inadequate (marked with 'IA' in Table 6), and only seven studies utilized a proper



(Table 6) Quality of Research

Type	First Author	Year	RDM	AC	BLDR	BLDA	ATR	QAS
MM	Nguyen*	2010	yes	yes	yes	yes	yes	5
	Kain*	2001	yes	yes	yes	yes	-	4
	Hatem*	2006	IA	-	-	yes	yes	2
	Kristjánsdóttir*	2011	yes	-	-	-	-	1
	Balan*	2009	yes	-	-	Yes	-	2
	Liu*	2007	IA	-	-	-	-	0
	Press	2003	NC	-	-	-	-	0
MT	Robb*	2008	IA	-	-	yes	yes	2
	Bradt*	2001	yes	-	-	-	yes	2
	Barry	2010	yes	-	-	-	yes	2
	Kain	2004	yes	-	-	yes	-	2
	Loewy*	2005	IA	-	-	-	yes	1
	Grasso*	2000	NC	-	-	-	yes	1
	Whitehead-Pleaux	2006	NC	-	-	-	-	0
Colwell	2005	NC	-	-	-	-	0	

Note. \* reported positive outcomes, RDM: Randomization, AC: Allocation concealment, BLDR: Blinding researcher, BLDA: Blinding assessor, ATR: Report on attrition rate, QAS: Quality appraisal score, IA: inadequate method, NC: not clear.

method of group allocation such as a table of random numbers, opaque envelopes, or computer generated numbers. Overall, omitting the details of procedures in their description was the main problem and made it impossible to appraise their study quality accurately (Table 6). Most studies did not implement or report allocation concealment or researcher blinding. MM studies more frequently overlooked the attrition rate in their intention to treat analysis. Overall, the poor QAS scores indicate problems with potential bias at all levels.

### 3. Outcome Measures

A total of thirty-six tools of five different types were administered to measure seven different outcomes. The most frequently obtained outcomes were related to pain and anxiety; these were also the only outcomes targeted by MM studies. MT studies also investigated coping, adherence to treatment regimen, ease of sedation, self-concept and time taken for treatments. All outcomes and measurements utilized in these fifteen studies are listed in Table 9 according to type.

〈Table 7〉 Study Characteristics: Music Medicine Studies

First Author (Year)	Country	Design	N	Setting	Medical Specialty	Age Range	Music	QAS
Balan* (2009)	India	3-arm Parallel	150	Outpatient	General	5-12	Toodi: Indian instrumental classical	1
Hatem* (2006)	Brazil	2-arm Parallel	79	Inpatient	Surgery (Cardiology)	0-16	Spring, Vivaldi Four Seasons	2
Kain* (2001)	USA	2-arm Parallel	70	Inpatient	Surgery (General)	2-7	Bach Air	4
Kristjánsdóttir* (2011)	Iceland	3-arm Parallel	118	Outpatient	General	13-15	Selection of teen preferred and one classical†	1
Liu* (2007)	USA	2-arm Parallel	69	Outpatient	Orthopedic	0.5-10	Soft lullaby music	0
Nguyen* (2010)	Vietnam	2-arm Parallel & mixed method	40	Inpatient	Oncology	7-12	Selection of Vietnamese songs and children's songs†	5
Press (2003)	Israel	2-arm Parallel	94	Outpatient	Emergency Medicine	6-16	One song with questions	0

Note. \* reported positive outcomes, QAS: quality appraisal scale, † indicates use of patient preferred music.

〈Table 8〉 Study Characteristics: Music Therapy Studies

First Author (Year)	Country	Design	N	Setting	Medical Specialty	Age Range	Music Engagement	Music	QAS
Bradt* (2001)	USA	Crossover	32	Inpatient	Orthopedic	8-19	Entrainment	Improvised†	2
Barry (2010)	Australia	2-arm Parallel & Mixed-Method	11	Outpatient	Oncology	6-13	Combination	CD created by Child and MT†	2
Colwell (2005)	USA	2-arm Parallel	24	Inpatient	Oncology	7-18	Creative	Computer Music†	0
Grasso* (2000)	Australia	2-arm Parallel	20	Outpatient	Pulmonology	0.4-2	Receptive	MT Created	1
Kain (2004)	USA	3-arm Parallel	123	Inpatient	Surgery (General)	2-7	Recreative	Children's Songs†	2
Loevy* (2005)	USA	2-arm Parallel	60	Inpatient	Diagnostic (General)	0.1-5	Receptive	Children's Song chosen by a parent and MT	1
Robb* (2008)	USA	3-arm Parallel	83	Inpatient	Oncology	4-7	Combination	Children's Songs†	2
Whitehead-Pleaux (2006)	USA	2-arm Parallel	14	Inpatient	Bum Center	6-16	Receptive	Children's Songs†	0

Note. \* reported positive outcomes, QAS: quality appraisal scale, † indicates use of patient preferred music.

〈Table 9〉 Measurement Tools

<b>Physiological</b>	Blood Pressure: (Hatem, 2006; Nguyen, 2010) Body Temperature: (Hatem, 2006) Heart Rate: (Hatem, 2006; Liu, 2007; Nguyen, 2010; Whitehead-Pleaux, 2006) Oxygen Saturation: (Hatem, 2006; Nguyen, 2010) Pain Threshold: Dolorimeter (Press, 2003) Respiration: (Hatem, 2006; Nguyen, 2010; Whitehead-Pleaux, 2006)
<b>Observational</b>	Anxiety: Yale Preoperative Anxiety Scale (Kain, 2001; Kain, 2004) Coping: Behavioral Coping (Robb, 2008; Whitehead-Pleaux, 2006) Pain: Scale of Nursing Assessment of Pain Index (Whitehead-Pleaux, 2006) Sedation: Induction Compliance Checklist (Kain, 2004) Temperament: EASI (Kain, 2004)
<b>Scale</b>	Anxiety: Fear Thermometer (Whitehead-Pleaux, 2006) Pain: <ul style="list-style-type: none"> <li>- Faces Scale (Hatem, 2006)</li> <li>- VAS on pain (Balan, 2009; Kristjánsdóttir, 2011; Press, 2003)</li> <li>- Numeric Rating Scale on Pain (Nguyen, 2010)</li> <li>- Wong Baker FACES Scale (Whitehead-Pleaux, 2006)</li> </ul> Sedation: Beth Israel medical center flow sheet sedation scale (Loewy, 2005) Treatment: Bipolar Likert-type Scales on Enjoyment (Grasso, 2000)
<b>Questionnaires</b>	Anxiety: State-Trait Anxiety Inventory (Kain, 2001; Kain, 2004) Coping: <ul style="list-style-type: none"> <li>- Kidcope (Barry, 2010)</li> <li>- Miller Behavioral Style Scale (Kain, 2001)</li> <li>- RT planning staff questionnaire (Barry, 2010)</li> </ul> Pain: <ul style="list-style-type: none"> <li>- Vami/Thompson Pediatric Pain Questionnaire (Bradt, 2001)</li> <li>- WHO-Euro cross-nation study of health-related behaviours in school (Kristjánsdóttir, 2011)</li> </ul> Self Concept: Piers-Harris Children's Self-Concept Scale (Colwell, 2005) Treatment Regimen: Question on perception of treatment duration (Grasso, 2000) "How long does CPT feel like it takes to complete?"
<b>Other</b>	Amount of Pain Medication: (Hatem, 2006) Distress: Qualitative questionnaire for parents (Barry, 2010) Researcher's clinical reflexive journal: (Barry, 2010) Sedation Time: Duration of and time taken till sedation (Loewy, 2005)

Note. Listed first authors only

#### 4. Music or Music Therapy Intervention

As Robb and Carpenter (2009) noted, information about interventions was often incomplete in the studies in this review. Details of interventions are tabulated in tables 10 and 11. All fifteen studies offered interventions on an individual basis with programs that lasted anywhere from 1 minute to 60 minutes, and were offered as a single treatment except for the studies by Bradt (2001) and Grasso (2000). The main differences between the MM and MT approaches were the range of interventions, and the level of participation and choices given to research participants. All seven MM studies offered only the receptive method while MT studies presented three or more styles of interventions. Five out of seven MM studies provided researcher-selected music while the remaining two offered selections to choose from. On the other hand, six out of eight MT studies incorporated participants' choice of music in their approach. In addition, MM studies used pre-recorded music only, while MT studies of receptive interventions offered live music only.

One of the factors known to cause heterogeneity is lack of standardized protocols (Naylor et al., 2011). Although offering choices and meeting the individual needs of participants are important concepts in therapeutic approaches, they make it difficult to standardize intervention protocols.

In this review, some studies employed the same intervention as a form of treatment for every patient, some studies developed ways to incorporate participants' individual choices in their intervention, and a third group provided individualized therapeutic intervention by a qualified clinician. In an effort to differentiate these different types of intervention, the author used the following terms; standardized, structured, and individualized respectively. For example, two music medicine studies (Kristjánsdóttir & Kristjánsdóttir, 2011; Nguyen et al., 2010) offered their participants selections of music to choose from which are categorized as 'structured.' In the same manner, MT studies that utilized patient-chosen music with a carefully developed music therapy protocol are also listed as 'structured' (refer to Tables 10 and 11). Creation of original music with computer software in music therapy (Barry, 2010; Colwell et al., 2005) was another way of structuring music therapy sessions.

〈Table 10〉 Details on Interventions: Music Medicine Studies

First author (year)	Main Outcome	Protocol	Selection	Intervention Style	Schedule	Delivery	Genre	Comparative Group
Balan* (2009)	Pain	STND	RES	Receptive	15min. Pre & peri, 5min. post	Earphone	Indian	Earphone/No music Anesthetic Cream
Hatem* (2006)	Pain	STND	RES	Receptive	30min. pre	Headphone	Classical	Headphone/No music
Kain* (2001)	Anxiety	STND	RES	Receptive	NC	Speaker	Classical	Standard care
Kristjánsdóttir* (2011)	Pain	STRC	PTS	Receptive	5min.	Speaker vs. headphone	Pop & Classical	Standard care
Liu* (2007)	Anxiety	STND	NC	Receptive	NC	Speaker	Lullaby	Standard care
Nguyen* (2010)	Pain	STRC	PTS	Receptive	10min. pre & peri	Earphone	Vietnamese Children's	Earphone/No music
Press (2003)	Pain	STND	RES	Receptive	1min. peri	Headphone	NC	Standard Care

Note. \* reported positive outcomes, STND: protocol standardized, STRC: protocol structured, IND: protocol individualized, RES: researcher chosen, PTS: participants chosen, NC: not clear, QAS: quality appraisal scale.

〈Table 11〉 Details on Interventions: Music Therapy Studies

First author	Main Outcome	Protocol	Selection	Intervention Style	Schedule	Delivery	Genre	Comparative Group
Bradl* (2001)	Pain	IND	PTS	Entrainment	30-45m twice	Live & Rec	Improvised	1. Crossover music x2 & control
Grasso* (2000)	Treatment Regimen	STND	RES	Receptive	12 times during physiotherapy	REC	NC	1. Standard Care + option of preferred music
Loewy* (2005)	Sedation Level	IND	Parent & RES	Receptive	20m pre	LIVE	Children's	1. Standard Care
Robb* (2008)	Coping	STRC	PTS	Active	20m	LIVE	Children's	1. Storybook 2. Music listening
Barry (2010)	Coping	STRC	PTS	Combined	10-90m	COMP & REC	Computer generated	1. Standard Care + option of preferred music
Colwell (2005)	Self Concept	STRC	PTS	Creative	45-60m	COMP & REC	Computer generated	1. Art activity
Kain (2004)	Anxiety	STRC	PTS	Combined	20-30m	LIVE	Children's	1. Standard Care 2. Midazolam
Whitehead-Pleaux (2006)	Pain/ Distress	IND	PTS	Receptive	peri	LIVE	Children's	1. Verbal support

Note. \* reported positive outcomes, STND: protocol standardized, STRC: protocol structured, IND: protocol individualized, RES: researcher chosen, PTS: participants chosen, NC: not clear, LIVE: live music, REC: recorded music, COMP: computer music, QAS: quality appraisal scale.

## 5. Description of Reported Outcomes

Six out of seven MM studies reported a significant effect of music on the given outcome whereas four out of the eight MT studies produced such an outcome as seen on Table 10 and 11. Overall, the sample size for MM studies was 1.7 times larger than the sample size for MT studies. MM studies also focused only on two outcomes, pain and anxiety. The research rigor in terms of average scores on quality assessment was generally poor for both practices, although two MM studies (Kain et al., 2001; Nguyen et al., 2010) demonstrated the use of solid strategies to minimize researcher bias such as allocation concealment, blinding all assessors and reporting intention to treat, including a proper method of randomization. These two studies also obtained highly significant results.

### 1) Outcomes of music medicine studies

As mentioned above, MM studies mainly investigated the effect of music on pain and anxiety levels using receptive methods. Five of the seven MM studies measured pain, and the remaining two evaluated anxiety. Balan (2009) found no differences in the scores of faces scale between groups that had local anesthetic cream and groups that heard Indian classical music during a venipuncture, while both were significantly different from the score of a control group. This meant that music was as effective as local anesthetic cream in lowering children's pain responses during a venipuncture. Another pain study by Hatem (2006) revealed that listening to 'Spring from Vivaldi's Four Seasons' for 30 minutes significantly lowered the heart rate and pain scale ratings of children who underwent cardiac surgery. Nguyen and colleagues (2010) offered patient selected Vietnamese traditional and children's songs during a lumbar puncture for children with leukemia, and found significantly lower heart rates and scores on pain scales. Kristjánsdóttir & Kristjánsdóttir (2011) investigated the effect of preferred music on procedural pain for teenagers during a routine immunization, and found that listening to music via loudspeakers was significantly more effective than listening to music through headphones or receiving standard care. Press and colleagues (2003) offered an active distraction by playing a song during a venipuncture then asking a question about the song, and found that there was no significant difference between the experimental and control group on the level of self-reported pain. However, a subsequent analysis suggested that the intervention was significantly effective for females and those with low white blood cell counts (< 12,000).



Two music medicine studies investigated the anxiolytic effect of music. Liu et al. (2007) compared the effect of lullaby music on the mean rise in heart rate for children undergoing a cast room procedure, and reported that the control group displayed a significantly higher increase in heart rate than the music group. In a study involving children undergoing elective surgeries, children who received a low sensory stimulation intervention paired with Bach's 'Air' in the operation suite showed significantly fewer anxiety associated responses than those who received standard care, as well as better compliance behaviors during the anesthesia induction (Kain et al., 2001).

## **2) Outcomes of music therapy studies**

In addition to looking at pain and anxiety related outcomes, MT researchers investigated the effect of music on coping skills, self-concept, adherence to treatment regimen, and ease of sedation. Bradt's study (2001) on post-op pain in children who had orthopedic surgery reported that entraining pain via improvised music significantly reduced self-reports of pain. The level of behavioral distress of pediatric burn patients undergoing donor site dressing changes was compared between a music therapy group and a placebo group (Whitehead-Pleaux, Baryza, & Sheridan, 2006). The result indicated that there was no significant difference between groups although a positive shift was observed in the within group analysis. Kain et al. (2004) compared the levels of pre-op anxiety between a midazolam group, music therapy group, and control group, and found that midazolam was more effective in reducing pre-op anxiety than the other two. A subsequent analysis revealed that a group that had one of the two therapists involved, had shown as significant a result as the midazolam group suggesting a potential therapist effect (Kain et al., 2004).

Robb et al. (2008) compared coping-related behaviors of pediatric cancer patients following active music engagement(AME), music listening(ML), and audio story book(ASB) conditions. They concluded that the AME group showed significant increases in positive facial affect and active engagement behaviors compared to other two groups. On the initiative behaviors, both AME and ML groups showed a significant increase compared to ASB group. Another study also investigated self-reported coping skills of pediatric oncology patients awaiting radiation therapy. There was no significant difference between the groups that created and listened to their own computer music and a control group that listened to preferred music, however the experimental group demonstrated the use of healthier coping strategies (Barry, 2010). Colwell and colleagues (2005) also offered the creation of a music

CD with computer software to a group of hospitalized children with cancer and compared their self-concept scores with another group that participated in art composition. Although there was no significant difference in self-concept between the groups, further exploration suggested that both music and art may improve the self-concept of pediatric oncology patients.

Loewy et al. (2005) conducted a study investigating time taken, duration, and quality of sedation for infants and toddlers undergoing EEG. They concluded that children who received live music therapy during the sedation process were significantly less likely to require another form of sedation such as chloral hydrate. In addition, the MT group was sedated less heavily and awoke from sedation more quickly than those who were given chloral hydrate.

Children with cystic fibrosis were provided with a tape specifically devised by a music therapist to assist chest physiotherapy (Grasso et al., 2000). The experimental group reported having a significantly more positive experience than the groups that listened to preferred music or no music.

### **3) Outcomes by intervention strategies**

Previous systematic reviews (Klassen et al., 2008; Mrázová & Celec, 2010) categorized music intervention as either 'active' or 'passive' while the current review divided them into 'music medicine' and 'music therapy.' As discussed, all of the MM studies reported using a passive approach whereas MT investigators employed various approaches or a combination of them. Two of the MM studies utilized classical music, selecting a piece based on other studies (Hatem et al., 2006; Kain et al., 2001). One study provided Indian classical music called 'Todi' with specific information about the style and instruments used (Balan et al., 2009), whereas another study completed a pilot project to gather information about music that teenagers preferred and compiled selections of popular and classical music (Kristjánssdóttir & Kristjánssdóttir, 2011). All of the above studies produced a significant effect.

Among the three studies that did not provide sufficient information about the music used, Nguyen et al.(2010) stated that the children were given an iPod to choose preferred songs to listen to which turned out to be Vietnamese traditional and children's songs. Liu, et al.(2007) reported using a compilation of lullaby music and Press et al.(2003) described the music only as a recorded song with lyrics. The first two studies produced positive results, while the study by Press et al. (2003) yielded inconclusive results. Since the studies with

questionable results also had low quality appraisal scores and lacked descriptions of many aspects of the procedure, it was not possible to draw conclusions based on these results.

One interesting finding from a MM study (Kristjánssdóttir & Kristjánssdóttir, 2011) was that using speakers to deliver music was significantly more effective than using headphones or earphones for adolescents during an immunization. Other researchers did not discuss this effect, rather some intentionally chose to deliver music via headphones or earphones to blind the researcher or assessors by playing a blank CD (Balan et al., 2009; Hatem et al., 2006; Nguyen et al., 2010). All MM studies investigated a single exposure to music of anywhere from 1 to 30 minutes. The study by Kain et al. (2001), which favored the use of the Bach 'Air' in the OR, explored the effect of "low sensory stimulation" with music, but did not specify how long the induction process took. Press and colleagues (2003) offered a song with lyrics as 'active distraction' by asking participants to listen to a song during their venipuncture and answer questions about the song later. Because the title or type of the song was not reported and the procedure was very brief, it is difficult to assess the role of music in this study. Though the study results were inconclusive, the researcher stressed that gender played a role in this case, and that girls benefitted to a greater degree than boys from this active distraction.

Music therapy studies in this review demonstrated a wide variety of approaches, including entrainment (Bradt, 2001), three receptive interventions using live or original music (Grasso et al., 2000; Loewy et al., 2005; Whitehead-Pleaux et al., 2006), two combined but mainly active music engagements (Kain et al., 2004; Robb et al., 2008), and lastly two combined but mostly creative approaches in which participants created their own music using computer software with a therapist (Barry, 2010; Colwell et al., 2005). In the four studies that yielded positive results, two provided the intervention more than twice (Bradt, 2001; Grasso et al., 2000), three utilized children's songs (except Bradt, 2001) and three provided live music incorporating the child's preference (Bradt, 2001; Loewy et al., 2005; Robb et al., 2008). The participants' mean age in the four studies with positive results was 5.88 ( $m = 3.11$  excluding Bradt's study) while the mean age of the other studies were 9.17.

Three of the four studies that reported inconclusive results involved participants whose medical conditions put them at higher risk for pain and poor medical outcomes than the other studies (oncology & burn care); these three studies also involved a comparative group rather than a true control or a standard care group (Barry, 2010; Colwell et al., 2005; Whitehead-Pleaux et al., 2006). Although Kain et al. (2004) suggested that it was the

therapist effect that resulted in an equivocal outcome, two studies that involved more than 7 music therapists did not report such an effect (Loewy et al., 2005; Robb et al., 2008).

## IV. Discussion

### 1. Summary of the Review:

This systematic review examined and compared 15 RCTs published between 2000 and 2012 on the topic of music for pediatric medical patients. There was a total of seven studies conducted by medical professionals, such as physicians, nurses and anesthesiologists defined as music medicine (MM) and eight studies administered by music therapists (MT) who had degrees, clinical training and credentials in the field of music therapy. Due to overall poor research rigor and limitations in methodology, a qualitative synthesis was performed not to draw definite conclusions, but to explore characteristics of the literature, identify gaps, observe patterns, and explore directions for future research. Pain and anxiety were the outcomes of interest in MM studies while several additional clinical outcomes were measured in the MT studies. Overall, music had a positive effect in decreasing procedural and post-op pain in five of the seven studies (Balan et al., 2009; Bradt, 2001; Hatem et al., 2006; Kristjánsdóttir & Kristjánsdóttir, 2011; Nguyen et al., 2010; Press et al., 2003; Whitehead-Pleaux et al., 2006). Two out of three studies on children's anxiety level associated with a medical procedure or surgery supported the use of classical or lullaby music to reduce anxiety among children (Kain et al., 2001; Kain et al., 2004; Liu et al., 2007). Active music engagement had a significantly positive influence on increasing coping behaviors of children with cancer (Robb et al., 2008), while listening to self-made computer music during radiation therapy appeared to have a limited but positive effect on improving coping skills for children with the same diagnosis (Barry, 2010). A tape devised by a music therapist was helpful in improving the experience of physiotherapy for toddlers with cystic fibrosis and their parents (Grasso et al., 2000), and a music therapy intervention with toddlers being sedated for EEG was significantly effective in improving and shortening the sedation process (Loewy et al., 2005). Lastly, composing music with computer software had a slight effect on improving the self-concept of children with cancer (Colwell et al., 2005).

## 2. Discussion of the Findings:

### 1) Music medicine vs. music therapy

In general, the results seem to indicate the effectiveness of MM more heavily than MT, and this calls for further exploration. Although the objectives appear to be similar, MM and MT are very different from each other because the agent for change, process of treatment the role of music and the interventionist are very different. Therefore, a direct comparison of the research results of MM and MT is impossible.

The differences between the two practices which emerged during the systematic review include: 1) MM targeted symptoms whereas MT addressed both symptoms and personal attributes: This means that MM was focused on decreasing negative reactions, such as pain and anxiety during medical procedures, whereas MT sought to improve the coping skills of the patients, their attitude towards medical treatment, and their sense of self-worth while managing the associated symptoms as well; 2) MM and MT addressed different groups with different medical needs and severity of conditions. Even in the pain studies, all but one MM study looked at brief and minor procedural pain, such as venipuncture or immunization, whereas MT studies involved patients undergoing painful procedures, such as donor site dressing changes or post-op recovery from orthopedic surgeries. Another fact to consider is the ratio of inpatient to outpatient settings. As seen in Table 5, a majority of MM studies were done in an outpatient setting, while the opposite was the case for MT studies, indicating that there were differences in the severity of medical problems; 3) Differences in methodological challenges: What defines music therapy also complicates the research process further. Dileo and Bradt (2005) indicated that there are many complicating factors in music therapy that increase confounding variables for MT studies. For example, the relationship between a client and a therapist, differences in each therapeutic process, and the use of a live or individualized approach contribute to the complexity of the therapeutic phenomena. Therefore, differences were found in overall methodological quality, sample size, and the number of measurements tools used. Consequently, MT faces many more challenges with recruiting, standardizing interventions, minimizing bias, limiting environmental factors, reducing therapist effect, and controlling for confounding variables.

### 2) Quality of research

Numerous MM and MT studies were categorized by poor research design and/or reporting

methods. The most frequent error was not reporting the details of methodology. Four studies did not specify the type of randomization method used, and eight studies did not report attrition rates. Thirteen studies did not discuss whether they considered allocation concealment or blinding the researcher, and only five addressed the issue of blinding assessors. As Naylor et al. (2011) point out, this can be addressed by following published guidelines for RCTs such as the CONSORT Statement (Schulz et al., 2010). Allocating participants according to the day or place at the time of recruitment is not considered an appropriate method of randomization; use of a table of random numbers, computer programs, or permuted block methods need to be considered instead. Quality of research determines the trustworthiness of the findings, thus every effort should be made to improve methodological rigor and the reporting process. Naylor et al. (2011) emphasize this when they state “The issue is not simply a lack of research but rather a lack of high quality research” (p. 15).

### **3) Issues of heterogeneity**

Even without statistical analysis, it was apparent that heterogeneity was a problem in the research methods, targeted outcomes, measurement tools, and clinical interventions. Scholars who have invested their time in this topic have also emphasized the importance of addressing this issue (Dileo & Bradt, 2005; Klassen et al., 2008; Mrázová & Celec, 2010; Naylor et al., 2011; Standley & Whipple, 2003). As a practical guide to addressing heterogeneity, Naylor et al. (2011) suggested obtaining larger sample sizes, standardizing intervention protocols, pursuing fewer outcomes, simplifying study design, employing a simple control or standard care group, utilizing relevant, reliable and valid measurement tools, and repeating similar investigations. In addition to developing a protocol for MT intervention, following a clinical decision tree, securing a sufficient number of training sessions for involved therapists, and providing supervision can further promote clinical homogeneity (C. Dileo, personal communication, October 26, 2012). These steps will also minimize issues raised by Kain et al. (2004) regarding therapist effect, as the effectiveness of MT greatly differed between the two music therapists in this study.

### **4) Preference of Music**

Music therapists heavily emphasize the importance of incorporating a patient's preferred music in their approach, and this was evident in seven of eight MT studies. On the other

hand, a majority of MM studies provided researcher-selected music rather than client-preferred music. Nguyen et al. (2010) provided an iPod to 7 to 12 year old children in the experimental group to pick the song they wanted to listen to during a venipuncture, while Kristjánsdóttir & Kristjánsdóttir (2011) provided CDs of recent top ten popular charts and one sedative classical music piece to teenage participants. Although it is not clear how many choices were given, Nguyen et al. (2010) reported that the children chose Vietnamese songs and children's songs. The researcher-chosen music, on the other hand, consisted of classical music and traditional songs.

MM studies that provided choices involved participants aged 7 and older ( $\bar{x} = 11.5$ ) while the studies that implemented researcher chosen music included younger children ( $\bar{x} = 6.71$ ), except for Press (Press et al., 2003) which included older children, and involved participants in the cognitive task of answering questions after the song. This may simply suggest that older children need choices, and younger children may respond to carefully selected music. Unlike other age groups that responded positively to classical and traditional music, teenagers preferred and benefitted from popular songs from top ten charts. This could also mean that age-appropriate, stimulating music may be more suited to older children. These are all questions that need to be addressed in future research.

##### **5) Improving research methodology**

There are many aspects of a pediatric medical setting that limit the researcher's ability to control the environment and maintain a rigorous execution of procedures. One of the most difficult challenges is securing adequate time and space for a study to take place, because the patient's ultimate reason for being in a hospital is to get medical treatment. Collaboration with medical professionals can be extremely helpful in dealing with such issues. In addition, Dileo & Bradt (2005) point out that collaboration can lead to refining the most pertinent research outcomes and measures. Collaborations can also assist with many issues in methodology and provide insights from multiple disciplines, thus improving the overall quality of the research.

Some important components of RCTs, such as double blinding and implementing a placebo group, need to be discussed. Although these measures seem inapplicable in music therapy research due to the nature of music therapy practice, C. Dileo (personal communication, October 26, 2012) suggests otherwise. It may be impossible to conduct a true double blind study where all involved participants and staff members are completely

blinded to the allocation, but obtaining an independent data collector, hiring therapists outside of the research team, and using a placebo group can help build a more rigorous research design. Examples of placebo interventions include listening to randomly selected music, engaging in self-directed music playing, engaging in musical games, or having a session without the therapist's intention to treat.

#### **6) Issues in distinction of music medicine and music therapy**

Much of the early work on the clinical application of music involved veterans after World War II; this work provided the momentum for music therapy to evolve as a health profession over the last 60-70 years (Davis, Gfeller, & Thaut, 2008). Because of this close connection between music and medicine, people from various backgrounds have shown interest in the use of recorded music as a clinical agent to alleviate symptoms such as pain and anxiety in medical settings and have conducted such research studies. Generally, most early studies titled their intervention as simply 'music,' yet some of them began to use the terms 'music' and 'music therapy' interchangeably. The definition of music therapy from scholars and professional associations in music therapy worldwide includes a concept of 'relationship' and 'trained music therapist.' Due to the major differences in the benefits derived from music listening and from a therapeutic relationship through music, Dileo classified the receptive use of music in medicine by medical personnel as 'music medicine'(Dileo, 1999). In this review, there were fewer studies than expected which claimed MM as MT. However, recent heated discussion about the terminology of music medicine and music therapy, such as between Gold et al.(2011) and Brandes (2011) point to the continuation of this problem and the need to address this matter consistently and constructively.

Regardless of the terminology, the distinction between MM and MT was apparent in the intervention itself, as all reviewed MM studies utilized a type of receptive intervention. However, one excluded study hired musicians to interact with children and parents during venipuncture (Caprilli et al., 2007). Although they studied the effect of interactive music as a symptom management during venipuncture, which is considered a minor issue with low health risk, studies as such may lead to an expansion of music programs for children and families facing imminent life-threatening issues found in other parts of hospitals such as oncology, cardiology, and intensive care units. If interactive interventions by untrained individuals expand to such serious cases, they could put children, families and hospitals in great danger as the interventionists are not able to fully comprehend or address the



emotional, psychological, psychosocial and spiritual needs of the patients and family members. Therefore, studies need to define the scope of practice and explore potential health risks attributable to lack of appropriate training.

An interesting interpretation of music therapy arose in Nguyen and colleagues(2010, p. 152) report which stated “Unlike active music therapy, the children were not limited to the music therapist’s repertoire” and “Music medicine is not time-consuming (as opposed to music therapy), and the time available is a complicating factor”. Music therapists are trained specifically to develop individually-tailored music therapy interventions, not only by considering the patient’s musical preference, but also by examining the clinical significance of music experiences to address the various clinical needs of a patient. The statement about music therapists’ being confined to their own repertoire clearly underlies the writer’s inaccurate view of the field of music therapy. Also, as discussed in this review, MM and MT cannot be compared to each other directly, because each approach targets different needs, utilizes separate methods, and addresses different goals. Stating MM is less time consuming than MT is an erroneous claim, as no such comparison is possible between these two interventions. It is this author’s opinion that these inaccurate portrayals of music medicine and music therapy accentuate the need for continued in-services, presentations, publications and interdisciplinary networking sessions among medical professionals.

### 3. Limitations

First, this study only investigated publications written in English, so the findings in this study cannot represent all published works worldwide. Second, articles published before the year 2000 were excluded for this study, and inclusion of all existing work over the past three decades might produce a different outcome. Third, although the researcher invested several days in searching all known databases exhaustively, the possibility exists that there are missing studies that meet all inclusion criteria. Fourth, the author used the quality appraisal scale only to rate the studies based on what was reported. Therefore, the results may not give an accurate assessment of the actual studies. Instead, they are an indicator of problems associated with reporting RCTs. Lastly, because the outcomes were not compared statistically, one should be careful of overgeneralizing the findings in this study.

### 4. Research Agenda

Needless to say, more RCTs are greatly needed with extensive improvements in their design, methodology, outcome measures, and more thorough reporting. Based on the existing body of literature and in collaboration with experts in different fields, the most relevant and significant outcome variables need to be identified to guide subsequent studies (Dileo & Bradt, 2005). Based on outcomes specific to the population involved and the area of medical specialty, studies need to investigate and compare various outcome measures to determine the most suitable and effective measurement tools that are also reliable and valid. Along with the accumulation of quality clinical trials, systematic reviews and meta-analyses need to be undertaken using more rigorous methods and analyses. Lastly, analysis of cost-effectiveness for music medicine and music therapy programs needs to be conducted to address the important financial benefits of the programs.

For studies in music medicine, comparisons of different methods of music selection, different genres and styles of music, and diverse ways of delivering music (i.e., speakers vs. headphones) need to be explored. Currently, there is great heterogeneity in the styles, genres and characteristics of music selected. Studies need to describe the rationale and strategy for selecting certain types of music over others. The effectiveness of relaxing music vs. stimulating music can be further explored with a focus on the choice of music. Choice of music can be broken down into three types: researcher-chosen music, participant-chosen music, and participant-preferred music among researcher devised albums or lists. In the first case, the researcher has full control over which music to use whereas in the second case, it is the participant who is responsible for picking the music he or she wants to listen to. The third type is a mixture of both in that the researcher provides a list of music for participants to look through, listen to briefly, then choose the music they want. Often times, it can be picking a CD of a preferred genre or style of music.

Medical professionals employing music medicine in their practice need to be surveyed regarding their level of knowledge and understanding of music therapy as a profession, their understanding of the scope of music medicine and possibilities for constructive discussions for distinguishing the two very important but different ways of using music in medicine.

Leading experts and educators in this area need to develop effective strategies for devising intervention protocols and training programs to insure a sufficient level of clinical skill across therapists with different levels of education and backgrounds. Researchers also need to investigate factors that yield differences among individual therapists and identify conclusive ways of addressing the issues. Studies are needed in the area of developing effective

treatment methods, theoretical frameworks, and specific music therapy treatment models for different patient groups, especially for those who present unique challenges, such as burn, comatose, AIDS, or organ failure needing transplantation. The inconsistency and heterogeneity found in the literature may be due to the lack of research on approaches and methodology themselves, thus studies need to explore and develop more effective intervention strategies for specific outcomes, settings, and populations as defined by age and cultural differences.

## V. Conclusion

A number of parents and children who have been helped by music therapy while undergoing medical treatment, would eagerly speak on behalf of the therapeutic effect of music; sometimes even comparing it to magic. However, music therapy researchers often fail to capture the same magnitude of effect in clinical trials. One of the most frequently mentioned issues in this paper was 'heterogeneity,' which reflects the nature of illness as it affects the person in multifaceted ways. Clinicians know that those multifaceted effects can only be addressed on an individual basis, which will naturally result in heterogeneous approaches. While it is a valid concern that many things which occur in a medical setting are neither controllable nor quantifiable, several researchers have found ways to overcome this problem through standardized interventions and rigorous methodology. Thus, future studies should focus on improving the research rigor and addressing heterogeneity issues for a continued advancement of music medicine and medical music therapy in children's health care settings.

## References

- \*Balan, R., Bavdekar, S. B., & Jadhav, S. (2009). Can indian classical instrumental music reduce pain felt during venepuncture? *Indian Journal of Pediatrics*, 76(5), 469-473.
- \*Barry, P. (2010). Music therapy CD creation for initial pediatric radiation therapy: A mixed methods analysis. *Journal of Music Therapy*, 47(3), 233-263.
- \*Bradt, J. (2001). *The effects of music entrainment on postoperative pain perception in pediatric patients*. (Ph.D., Temple University). ProQuest Dissertations and Theses, (251736733).
- Bradt, J., Magee, W. L., Dileo, C., Wheeler, B., & McGilloway, E. (2010). Music therapy for acquired brain injury. *Cochrane Database of Systematic Reviews (Online)*, (7), CD006787.
- Brandes, V. (2011). Reply to 'music therapy or music medicine?'. *Psychotherapy and Psychosomatics*, 80(5), 305.
- Caprilli, S., Anastasi, F., Grotto, R. P., Abeti, M., & Messeri, A. (2007). Interactive music as a treatment for pain and stress in children during venipuncture: A randomized prospective study. *Journal of Developmental and Behavioral Pediatrics: JDBP*, 28(5), 399-403.
- \*Colwell, C. M., Davis, K., & Schroeder, L. K. (2005). The effect of composition (art or music) on the self-concept of hospitalized children. *Journal of Music Therapy*, 42(1), 49-63.
- CONSORT (2012). CONSORT endorsers - journals. Retrieved 11/27/2012, from <http://www.consort-statement.org/about-consort/consort-endorsement/consort-endorsers---journals/>
- Davis, W. B., Gfeller, K. E., & Thaut, M. H. (2008). *An introduction to music therapy: Theory and practice*. (3rd ed). Silver Spring, MD: American Music Therapy Association.
- Dileo, C. (1999). *Music therapy and medicine: Theoretical and clinical applications*. Silver Spring, MD: American Music Therapy Association.
- Dileo, C., & Bradt, J. (2005). *Medical music therapy: A meta-analysis & agenda for future research*. Cherry Hill, N.J: Jeffrey Books.
- Gold, C., Erkkilä, J., Bonde, L. O., Trondalen, G., Maratos, A., & Crawford, M. J. (2011). Music therapy or music medicine? *Psychotherapy and Psychosomatics*, 80(5), 304; author reply 305.
- \*Grasso, M. C., Button, B. M., Allison, D. J., & Sawyer, S. M. (2000). Benefits of music

- therapy as an adjunct to chest physiotherapy in infants and toddlers with cystic fibrosis. *Pediatric Pulmonology*, 29(5), 371-381.
- \*Hatem, T., Lira, P., & Mattos, S. (2006). The therapeutic effects of music in children following cardiac surgery. *Jornal De Pediatria*, 82(3), 186-192.
- \*Kain, Z. N., Caldwell-Andrews, A., Krivutza, D. M., Weinberg, M. E., Gaal, D., Wang, S., & Mayes, L. C. (2004). Interactive music therapy as a treatment for preoperative anxiety in children: A randomized controlled trial. *Anesthesia and Analgesia*, 98(5), 1260.
- \*Kain, Z. N., Wang, S. M., Mayes, L. C., Krivutza, D. M., & Teague, B. A. (2001). Sensory stimuli and anxiety in children undergoing surgery: A randomized, controlled trial. *Anesthesia and Analgesia*, 92(4), 897-903.
- Klassen, T. P., Klassen, J. A., Liang, Y., Tjosvold, L., & Hartling, L. (2008). Music for pain and anxiety in children undergoing medical procedures: A systematic review of randomized controlled trials. *Ambulatory Pediatrics*, 8(2), 117-128.
- \*Kristjánssdóttir, Ó., & Kristjánssdóttir, G. (2011). Randomized clinical trial of musical distraction with and without headphones for adolescents' immunization pain. *Scandinavian Journal of Caring Sciences*, 25(1), 19-26.
- Lepore, S. J., Miles, H. J., & Levy, J. S. (1997). Relation of chronic and episodic stressors to psychological distress, reactivity, and health. *International Journal of Behavioral Medicine*, 4(1), 39.
- \*Liu, R. W., Mehta, P., Fortuna, S., Armstrong, D. G., Cooperman, D. R., Thompson, G. H., & Gilmore, A. (2007). A randomized prospective study of music therapy for reducing anxiety during cast room procedures. *Journal of Pediatric Orthopedics*, 27(7), 831-833.
- \*Loewy, J., Hallan, C., Friedman, E., & Martinez, C. (2005). Sleep/Sedation in children undergoing EEG testing: A comparison of chloral hydrate and music therapy. *Journal of PeriAnesthesia Nursing*, 20(5), 323-331.
- Mrázová, M., & Celec, P. (2010). A systematic review of randomized controlled trials using music therapy for children. *Journal of Alternative and Complementary Medicine (New York, N.Y.)*, 16(10), 1089-1095.
- Naylor, K. T., Kingsnorth, S., Lamont, A., McKeever, P., & Macarthur, C. (2011). The effectiveness of music in pediatric healthcare: A systematic review of randomized controlled trials. *Evidence-Based Complementary and Alternative Medicine : ECAM*, 2011, 464759-18.

- \*Nguyen, T. N., Nilsson, S., Hellström, A., & Bengtson, A. (2010). Music therapy to reduce pain and anxiety in children with cancer undergoing lumbar puncture: A randomized clinical trial. *Journal of Pediatric Oncology Nursing: Official Journal of the Association of Pediatric Oncology Nurses*, 27(3), 146-155.
- \*Press, J., Gidron, Y., & Maimon, M. (2003). Effects of active distraction on pain of children undergoing venipuncture: Who benefits from it? *Pain Clinic*, 15, 261-269.
- Robb, S. L., & Carpenter, J. (2009). A review of music-based intervention reporting in pediatrics. *Journal of Health Psychology*, 14(4), 490-501.
- \*Robb, S. L., Clair, A. A., Watanabe, M., Monahan, P. O., Azzouz, F., Stouffer, J.,... Hannan, A. (2008). A non-randomized [corrected] controlled trial of the active music engagement (AME) intervention on children with cancer. *Psycho-Oncology*, 17(7), 699-708.
- Schulz, K. F., Altman, D. G., Moher, D., & CONSORT Group. (2010). CONSORT 2010 statement: Updated guidelines for reporting parallel group randomized trials. *Annals of Internal Medicine*, 152(11), 726.
- Standley, J. M., & Whipple, J. (2003). Music therapy with pediatric patients: A meta-analysis. In S. L. Robb (Ed.), *Music therapy in pediatric healthcare: Research and evidence-based practice* (pp. 1-18). Silver Spring, MD: American Music Therapy Association.
- \*Whitehead-Pleaux, A., Baryza, M. J., & Sheridan, R. L. (2006). The effects of music therapy on pediatric patients' pain and anxiety during donor site dressing change. *Journal of Music Therapy*, 43(2), 136-153.

Notes. \* indicates studies reviewed in this paper.

## Bibliography of Excluded Articles

- Aldridge, K. (1993). The use of music to relieve pre-operational anxiety in children attending day surgery. *The Australian Journal of Music Therapy*, 4, 19-35.
- Arts, S. E., Abu-Saad, H. H., Champion, G. D., Crawford, M. R., Fisher, R. J., Juniper, K. H., & Ziegler, J. B. (1994). Age-related response to lidocaine-prilocaine (EMLA) emulsion and effect of music distraction on the pain of intravenous cannulation. *Pediatrics*, 93(5), 797.
- Caprilli, S., Anastasi, F., Grotto, R. P., Abeti, M., & Messeri, A. (2007). Interactive music as a treatment for pain and stress in children during venipuncture: A randomized prospective study. *Journal of Developmental and Behavioral Pediatrics: JDBP*, 28(5), 399-403.
- Chetta, H. D. (1981). The effect of music and desensitization on preoperative anxiety in children. *Journal of Music Therapy*, 18(2), 74-87.
- Filcheck, H. A., Allen, K. D., Ogren, H., Darby, J. B., Holstein, B., & Hupp, S. (2005). The use of choice-based distraction to decrease the distress of children at the dentist. *Child & Family Behavior Therapy*, 26(4), 59-68.
- Fowler-Kerry, S., & Lander, J. R. (1987). Management of injection pain in children. *Pain*, 30(2), 169-175.
- Fratianne, R. B., Prensner, J., Huston, M., Super, D., Yowler, C. J., & Standley, J. M. (2001). The effect of music-based imagery and musical alternate engagement on the burn debridement process. *Journal of Burn Care & Rehabilitation*, 22(1), 47-53.
- Froehlich, M. A. R. (1984). A comparison of the effect of music therapy and medical play therapy on the verbalization behavior of pediatric patients. *Journal of Music Therapy*, 21, 2-15.
- Hendon, C., & Bohon, L. M. (2008). Hospitalized children's mood differences during play and music therapy. *Child: Care, Health and Development*, 34(2), 141-144.
- Holm, L., & Fitzmaurice, L. (2008). Emergency department waiting room stress: Can music or aromatherapy improve anxiety scores? *Pediatric Emergency Care*, 24(12), 836-838.
- Jeffs, D. A. (2007). A pilot study of distraction for adolescents during allergy testing. *Journal for Specialists in Pediatric Nursing*, 12(3), 170-185.
- Kemper, K. J., Hamilton, C. A., McLean, T. W., & Lovato, J. (2008). Impact of music on pediatric oncology outpatients. *Pediatric Research*, 64(1), 105-109.

- Kim, S. J., Oh, Y. J., Kim, K. J., Kwak, Y., & Na, S. (2010). The effect of recorded maternal voice on perioperative anxiety and emergence in children. *Anaesthesia and Intensive Care*, 38(6), 1064-1069.
- Lane, D. (1991). *The effect of a single music therapy session on hospitalized children as measured by salivary immunoglobulin A, speech pause time, and a patient opinion likert scale.* (Ph.D., Case Western Reserve University). *ProQuest Dissertations and Theses*. (303924498).
- Madden, J. R., Mowry, P., Gao, D., Cullen, P. M., & Foreman, N. K. (2010). Creative arts therapy improves quality of life for pediatric brain tumor patients receiving outpatient chemotherapy. *Journal of Pediatric Oncology Nursing: Official Journal of the Association of Pediatric Oncology Nurses*, 27(3), 133-145.
- Malone, A. B. (1996). The effects of live music on the distress of pediatric patients receiving intravenous starts, venipunctures, injections, and heel sticks. *Journal of Music Therapy*, 33(1), 19-33.
- Megel, M. E., Houser, C. W., & Gleaves, L. S. (1998). Children's responses to immunizations: Lullabies as a distraction. *Issues in Comprehensive Pediatric Nursing*, 21(3), 129-145.
- Noguchi, L. K. (2006). The effect of music versus nonmusic on behavioral signs of distress and self-report of pain in pediatric injection patients. *Journal of Music Therapy*, 43(1), 16-38.
- Oelkers-Ax, R., Leins, A., Parzer, P., Hillecke, T., Bolay, H. V., Fischer, J., ... Resch, F. (2008). Butterbur root extract and music therapy in the prevention of childhood migraine: An explorative study. *European Journal of Pain*, 12(3), 301-313.
- Pfaff, Valerie K., Smith, Karen E., Gowan, Darryl. (1989). The effects of music-assisted relaxation on the distress of pediatric cancer patients undergoing bone marrow aspirations. *Children's Health Care*, 18(4), 232.
- Rickert, V. I., Kozlowski, K. J., Warren, A. M., Hendon, A., & Davis, P. (1994). Adolescents and colposcopy: The use of different procedures to reduce anxiety. *American Journal of Obstetrics and Gynecology*, 170(2), 504-508.
- Robb, S. L. (2000). The effect of therapeutic music interventions on the behavior of hospitalized children in isolation: Developing a contextual support model of music therapy. *Journal of Music Therapy*, 37(2), 118-145.
- Robb, S. L., & Ebberts, A. G. (2003). Songwriting and digital video production interventions for pediatric patients undergoing bone marrow transplantation, part I: An analysis of



- depression and anxiety levels according to phase of treatment. *Journal of Pediatric Oncology Nursing*, 20(1), 2-15.
- Robb, S. L., & Ebberts, A. G. (2003). Songwriting and digital video production interventions for pediatric patients undergoing bone marrow transplantation, part II: An analysis of patient-generated songs and patient perceptions regarding intervention efficacy. *Journal of Pediatric Oncology Nursing*, 20(1), 16-25.
- Robb, S. L., Nichols, R. J., & Rutan, R. L. (1995). The effects of music assisted relaxation on preoperative anxiety. *Journal of Music Therapy*, 32(1), 2-21.
- Shapiro, M., Melmed, R. N., Sgan-Cohen, H., Eli, I., & Parush, S. (2007). Behavioural and physiological effect of dental environment sensory adaptation on children's dental anxiety. *European Journal of Oral Sciences*, 115(6), 479-483.
- Weiss, J. H., Lyness, J., Molk, L., & Riley, J. (1976). Induced respiratory change in asthmatic children. *Journal of Psychosomatic Research*, 20(2), 115-123.
- Whitehead-Pleaux, A., Zebrowski, N., Baryza, M. J., & Sheridan, R. L. (2007). Exploring the effects of music therapy on pediatric pain: Phase 1. *Journal of Music Therapy*, 44(3), 217-241.

- 게재신청일: 2013. 10. 09.
- 수정투고일: 2013. 11. 13.
- 게재확정일: 2013. 11. 20.