Canadian Association of Music Therapists
Association canadienne des musicothérapeutes

Canadian Journal of Music Therapy
Revue canadienne de musicothérapie

Can Music Improve Sleep Quality? A Systematic Literature Review

La musique peut-elle améliorer la qualité du sommeil? : un examen systématique de la littérature

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Literature Review / Examen de la littérature

Keywords: music therapy, music, music intervention, sleep quality, sleep, insomnia

Mots-clés : musicothérapie, interventions musicales, qualité du sommeil, sommeil, insomnie

Journal Information
À propos de la revue

Volume 27 | 2021

Editor-in-Chief
Rédactrice en chef
SarahRose Black, PhD, RP, MTA

ISSN: 1199-1054

Frequency /Fréquence : annual/annuelle

Abstract

Poor sleep quality (PSQ) can have long-term effects leading to serious health issues. As more people turn to non-medical treatments, including the use of music for improving sleep quality, health professionals need to be aware of how to use music effectively. This systematic literature review investigated, synthesized, and analyzed 56 studies concerning the impact of music on sleep quality that were published between January 2007 and December 2019. The authors found the studies: (a) were conducted by a variety of research disciplines from multiple countries; (b) investigated a large number of participants from various clinical and non-clinical populations; (c) employed an array of research designs, interventions, measurement tools, and rationales for music choice, and (d) found mostly positive results. Of the 56 studies, 52 (92.9%) showed a positive influence of music on sleep quality, while 4 (7.1%) found no impact. Seven (12.5%) articles reported that music had a greater or equal impact on sleep quality compared to other treatments. Future research should include more detailed descriptions of music interventions in order to find the most effective music interventions for improving the sleep quality of different populations.

Keywords: music therapy, music, music intervention, sleep quality, sleep, insomnia

Sommaire

À long terme, un sommeil de mauvaise qualité peut entraîner de graves problèmes de santé. Comme de plus en plus de gens optent pour des traitements non médicaux, notamment en recourant à la musique pour améliorer la qualité du sommeil, les professionnels de la santé doivent savoir comment utiliser efficacement la musique. Cet examen systématique de la littérature se veut l'étude, la synthèse et l'analyse de 56 études portant sur l'incidence de la musique sur la qualité du sommeil publiée entre janvier 2007 et décembre 2019. Les auteurs ont constaté que les études (a) ont été réalisées par des chercheurs provenant de disciplines et de pays variés; (b) ont été menées auprès d'un grand nombre de participants issus de populations cliniques et non cliniques; (c) faisaient appel à toute une gamme de modèles de recherche, d'interventions, d'outils de mesure et de contextes pour les choix musicaux; et (d) ont donné lieu à des résultats majoritairement positifs. De ces 56 études, 52 (92,9 %) ont démontré une incidence positive de la musique sur la qualité du sommeil, tandis que 4 (7,1 %) n'en dégageaient aucune. Sept articles (12,5 %) indiquent que la musique a un effet d'importance égale ou supérieure aux autres traitements visant à accroître la qualité du sommeil. Il faudrait que les travaux de recherche futurs prévoient des descriptions plus détaillées d'interventions musicales pour découvrir lesquelles sont les plus efficaces pour améliorer la qualité du sommeil de différentes populations.

Mots-clés : musicothérapie, interventions musicales, qualité du sommeil, sommeil, insomnie

Introduction

People from all over the world are plagued by sleep disorders (Soldatos et al., 2005). Researchers have found that poor sleep quality (PSQ) can have long-term effects leading to serious health issues, including increased risk of mortality (Kojima et al., 2000), depression (Baglioni et al., 2011), and cardiovascular disease (Hoevenaar-Blom et al., 2011). Having PSQ can also create a vicious cycle of developing psychological disorders, which in turn can impair sleep further (Drake et al., 2003).

Pharmacological treatments have been used to manage sleep disorders (Tariq & Pulisetty, 2008). However, they potentially come with harmful side effects (DiBonaventura et al., 2015). As a solution, some non-pharmacological treatments, like cognitive-behavioural therapy (CBT) (Martínez et al., 2014), progressive muscle relaxation (PMR) (Saeedi et al., 2012), exercise (Kline et al., 2011), and sleep hygiene (Brick et al., 2010), have been studied for improving sleep quality. Along with these, music—known for reducing stress and anxiety—is often promoted as a holistic, non-pharmacological intervention to help people sleep better (De Niet et al., 2009; Street et al., 2014).

Researchers from various fields have explored the use of music to address the sleep problems of various populations. Chan and colleagues (2010) found elderly study participants benefitted from improved sleep quality and depression levels after listening to music they chose. According to Chen and colleagues (2014), listening to sedative music improved the sleep quality of young adults with long sleep latency. De Niet and colleagues (2010) found that music-assisted relaxation (MAR) helped mental health inpatients sleep better. Lafçi and Öztunç (2015) discovered listening to soft Turkish music improved sleep in Turkish breast cancer patients. Loewy and colleagues (2013) found live music interventions improved the sleep quality of premature infants.

Three meta-analyses examined the effect of music on sleep. De Niet and colleagues (2009) analyzed five randomized control trials (RCT) and found that MAR had a moderate positive effect on the sleep quality of adults and the elderly with various conditions. Wang and colleagues (2014) examined 10 RCTs and suggested that receptive music interventions were beneficial for promoting the sleep quality of adults with acute and chronic sleep problems. Feng and colleagues (2018) reviewed 20 studies and found that listening to music was helpful for improving the sleep quality of adults with primary insomnia. However, as Wang et al. (2014) pointed out, there are no standard guidelines for using music to improve sleep quality. The insufficient description of music interventions may cause reliability problems with the cross-study comparisons conducted in these reviews (Robb et al., 2010). In their review, De Niet et al. (2009) did not discriminate between different types of MARs when comparing the use of MAR by itself and MAR with other relaxation treatments. Wang and colleagues (2014) discussed the importance of music selection and intervention procedure; however, these elements were not thoroughly examined. Feng and colleagues (2018) compared listening to music and listening to music in combination with other treatments like acupuncture, but they did not discuss the details of the music interventions.

Other limitations of these aforementioned reviews include the limited scope of the reviewed populations and music interventions. In all of the reviews, people younger than 18 were excluded. Experiments with participants from particular clinical populations, such as people with neurological or cognitive disorders, were also excluded. These exclusions may benefit the meta-analysis by increasing the homogeneity. However, since these reviewers provided no evidence that music interventions promote the sleep quality of different populations for different reasons, the authors of the current study think it is important to include a broader range of populations. Two of the reviews set “active use of music such as playing instruments” (De Niet et al., 2009, p. 1358; Wang et al., 2014, p. 52) as an exclusion criterion for selecting studies. To have a complete understanding of how music can be used to promote improved sleep, a review investigating all methods of employing music interventions to aid in the promotion of sleep quality is necessary.

To fill these gaps, this systematic literature review aims to organize current knowledge about music and sleep quality, regardless of the target population and the type of music interventions used.

The following two questions guided this review:

1. Can music interventions be used to improve sleep quality?
2. What music interventions can be used to improve sleep quality?

Method

The authors consulted the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (Liberati et al., 2009) and Robb and colleagues' (2010) guidelines for reporting music-based interventions when writing the current review.

Inclusion and Exclusion Criteria

To be included, the research had to be: (a) focused on the impact of music interventions on humans' sleep quality, (b) primary experimental research, (c) peer-reviewed, including journal articles and master's or doctoral theses, and (d) published between January 2007 and December 2019.

The exclusion criteria were established as follows: (a) literature published before 2007 or after 2020, (b) literature not written in English, (c) secondary research, and (d) theoretical research, heuristic self-inquiries, and surveys.

Search Strategy

First, author BP employed a search syntax with Boolean operators—("music" OR "song") AND ("sleep" OR "insomnia")—to search 13 databases (see Table 1). The terms "music therapy," "sleep quality," and "sleep disorder" were not included in the syntax because they apply to a subset of literature that can be searched with keywords, "music" and "sleep," respectively. "Song" and "insomnia" were used as alternative terms for "music" and "sleep," respectively. Additionally, author EP used the same syntax to search 11 music therapy journals (see Table 2). Finally, BP manually searched the citations of three literature reviews (De Niet et al., 2009; Feng et al., 2018; Wang et al., 2014).

Table 1
Electronic Databases Searched

Search Engine	Database
APA PsycNET	PsycARTICLES
	PsycINFO
EBSCOhost	Academic Search Complete
	Art Full Text (H.W. Wilson)
	Psychology and Behavioral Sciences Collection
	RILM abstracts of music literature
Google	Google Scholar
ProQuest	ERIC
	Humanities Index
	ProQuest Dissertations & Theses Global
NCBI	PubMed Central (Free Journals)
	PubMed (Medline)
Web of Science	Web of Science

Table 2
Music Therapy Journals Searched

Search Access	Journal
EBSCOhost	Qualitative Inquiries in Music Therapy
Free Access	Music Therapy Today
Oxford Journals	Journal of Music Therapy
	Music Therapy Perspectives
ProQuest	Australian Journal of Music Therapy
	Canadian Journal of Music Therapy
	New Zealand Journal of Music Therapy
Taylor & Francis Journals	Approaches: An Interdisciplinary Journal of Music Therapy
	Nordic Journal of Music Therapy
	Voices: A World Forum for Music Therapy
SAGE Journals	British Journal of Music Therapy

BP used Zotero to organize the literature and remove duplicated studies. Together the authors reviewed the titles, abstracts, and keywords of the remaining literature to remove the unqualified articles. The full texts of the preliminarily qualified literature were retrieved. Next, the authors examined each article independently to finalize the included articles.

Data Analysis Procedure

The researchers consulted Robb and colleagues' (2010) guidelines for reporting music-based interventions to examine how these music interventions were used to promote sleep quality. The template of the items the researchers used to code the literature can be found in Table 3. The authors extracted information according to the template and recorded it in an Excel spreadsheet separately, then compared their results to reach an agreement. To clarify confusing categories, the country of the study refers to where the study was conducted. The background of the authors was checked to help determine whether a music therapist was involved. Based on the Excel spreadsheet, the authors applied descriptive statistics to analyze and categorize the literature and synthesized key elements of the interventions. BP used Review Manager 5 (RevMan) to calculate the within-group effect sizes (Cohen's *d*) for the music groups of the studies that used the Pittsburgh Sleep Questionnaire Index (PSQI) as an outcome.

Table 3
Classification Template

Section	Item
Author & Publication	Author's background; Year of publication; Involvement of music therapist(s); Country where study was conducted; Field of publication journal
Participants	Age; Clinical population; Number of participants
Research Method	Number of conditions; Allocation method, Measurement instrument(s)
Interventions	Duration; Frequency; Treatment period; Type of intervention(s); Music used; Rationale for music choice; Music delivery method.
Results	Research findings; Statistical significance of the result; Effect size

Results

The PRISMA Flowchart in Figure 1 shows the process of retrieving the 56 reviewed studies (Liberati et al., 2009). Figure 2 shows a trend of an increasing number of studies published in each year. The studies were published in journals from a wide range of fields (Table 4) by researchers from a variety of countries (Table 5). An ID number was assigned to each study, as shown in Table 4.

Figure 1

Stage of Selection Process Based on the PRISMA Flowchart Guideline

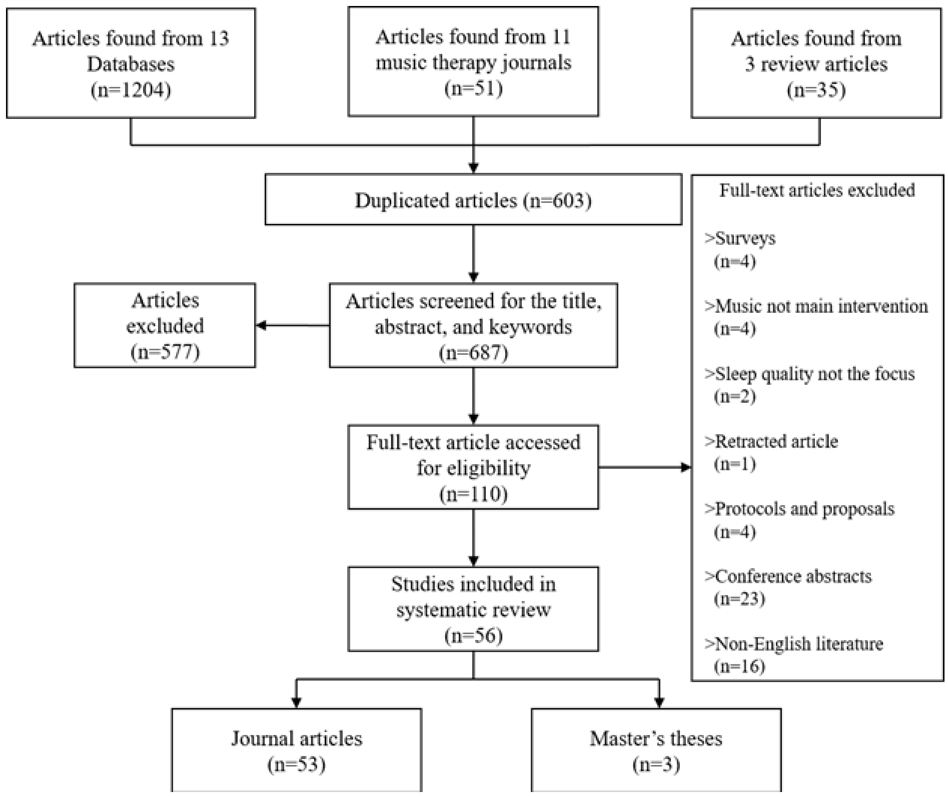


Figure 2

Publication Year of Reviewed Literature

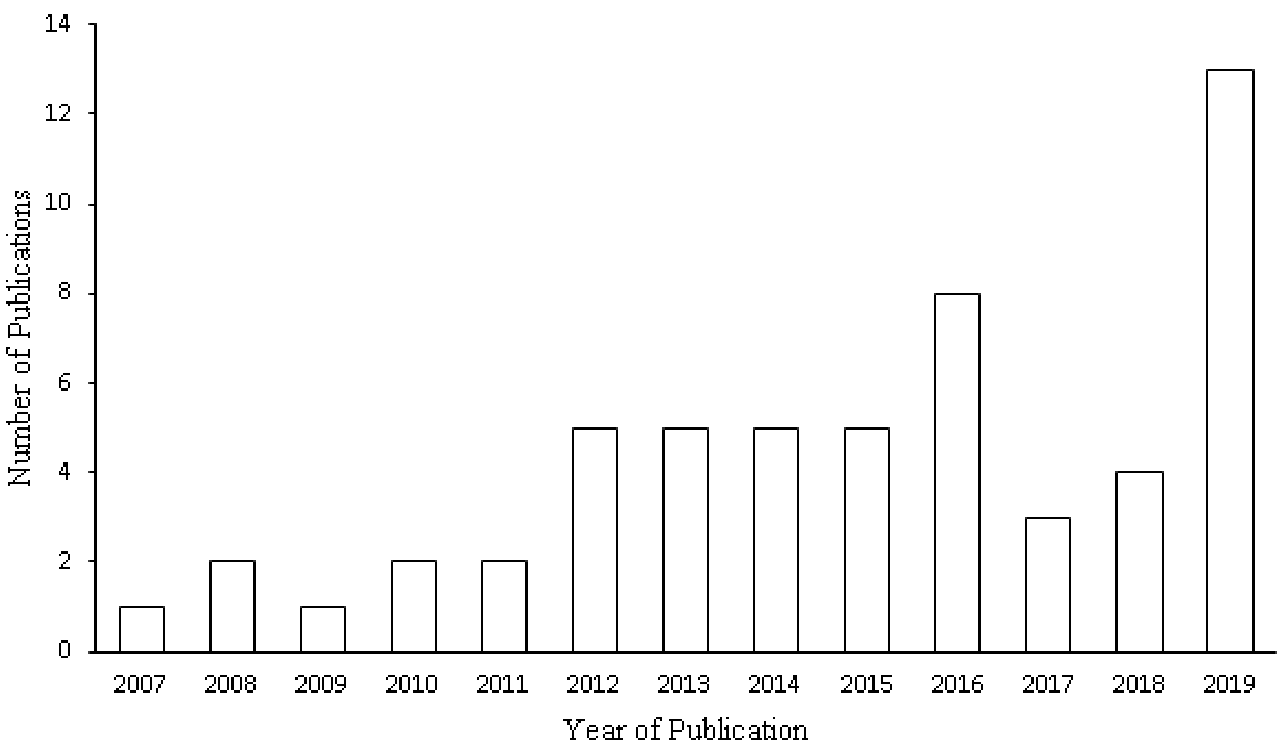


Table 4
Resource of Reviewed Literature

Journal Title/University	Author(s) (Year)	ID
Music Therapy		
Australian J. of Music Therapy	Oxtoby et al. (2013)	[1]
J. of Music Therapy	Ziv et al. (2008)	[2]
	Bloch et al. (2010)	[3]
	Jespersen & Vuust (2012)	[4]
Nordic J. of Music Therapy	Deshmukh et al. (2009)	[5]
	Koenig et al. (2013)	[6]
	Garunkstiene et al. (2014)	[7]
	Uhlig et al. (2018)	[8]
Nursing		
Applied Nursing Research	Huang et al. (2016)	[9]
Biological Research for Nursing	Lai et al. (2015)	[10]
British Association of Critical Care Nurses	Hansen et al. (2017)	[11]
Comprehensive Child and Adolescent Nursing	Anggerainy et al. (2019)	[12]
Critical Care	Hu et al. (2015)	[13]
Holistic Nursing Practice	Street et al. (2014)	[14]
Intensive & Critical Care Nursing	Pagnucci et al. (2019)	[15]
Int. J. of Nursing and Health Service	Naulia et al. (2019)	[16]
Int. J. of Nursing Studies	Chang et al. (2012)	[17]
J. of Advanced Nursing	Harmat et al. (2008)	[18]
	Su et al. (2013)	[19]
J. of Clinical Nursing	Ryu et al. (2012)	[20]
J. of Psychiatric Nursing	Altan Sarikaya & Oguz (2016)	[21]
Medical-Surgical Nursing J.	Ardabili et al. (2016)	[22]
Medical		
Acta Paediatrica	Stokes et al. (2018)	[23]
Brazilian J. of Psychiatry	Liu et al. (2019)	[24]
Int. J. of Innovative Studies in Medical Sciences	Kumar et al. (2019)	[25]
Int. J. of Medical Research and Health Sciences	Shobeiri et al. (2016)	[26]
J. of Family Medicine and Primary Care	Dubey et al. (2019)	[27]
J. of Turgut Ozal Medical Center	Huzmeli et al. (2018)	[28]
Pediatrics	Loewy et al. (2013)	[29]

The J. of Alzheimer's Disease	Innes et al. (2016)	[30]
Complementary Medicine		
Chinese Medicine and Culture	Fung et al. (2019)	[31]
Complementary Therapies in Medicine	Chan et al. (2010)	[32]
	Shum et al. (2014)	[33]
	Huang et al. (2017)	[34]
European J. of Integrated Medicine	Momennasab et al. (2018)	[35]
J. of Neurotherapy	DuRousseau et al. (2011)	[36]
The J. of Alternative and Complementary Medicine	Chen et al. (2014)	[37]
Other Health-Related Fields		
International J. of Caring Sciences	Lafçi, & Öztunç (2015)	[39]
J. of Biology, Agriculture, and Health	Gonzales (2013)	[40]
J. of Clinical Psychopharmacology	Bang et al. (2019)	[41]
Pain Research and Management	Picard et al. (2014)	[42]
Women and Health	Liu et al. (2016)	[43]
Psychology		
International J. of Indian Psychology	Mottaghi et al. (2015)	[44]
International J. of Psychophysiology	Lazic, & Ogilvie (2007)	[45]
Mental Illness	Blanaru et al. (2012)	[46]
Others		
IEEE Access	Lee et al. (2019)	[47]
Int. J. of Science and Research	Hemavathy & Muthamizh Selvan (2016)	[48]
J. of Sleep Research	Jespersen et al. (2019)	[49]
J. of Social Sciences	Vinayak et al. (2017)	[50]
Scientific Report	Cordi et al. (2019)	[51]
Sleep Science	Hausenblas et al. (2019)	[52]
Voices of Research	Sharma & Sharma (2015)	[53]
Theses		
Boston U. (Master of Science)	Kolesnik (2012)	[54]
Florida State U. (Master of Music)	Patterson (2011)	[55]
Montana State U. (Dr. of Nursing Practice)	Olds (2019)	[56]

Note. Abbreviation: Int. = International, J. = Journal

Table 5
Geographic Distribution of Reviewed Literature

Americas		Asia		Europe		Oceania	
Canada	2	China	12	Denmark	3	Australia	1
U.S.A.	9	India	5	Germany	1		
		Indonesia	2	Hungary	1		
		Iran	5	Israel	3		
		Singapore	1	Italy	1		
		South Korea	3	Lithuania	1		
		The Philippines	1	Netherlands	1		
		Turkey	3	Switzerland	1		

Population and Sample Size

The researchers of the reviewed studies investigated a wide range of populations (Table 6). There were 2,982 participants included in all of the studies, 561 of which were from 5 non-clinical populations, 2,420 of which were from 15 clinical populations. The populations with the largest number of participants were people with insomnia or PSQ, premature infants, and cancer patients.

Table 6
Population and Sample Size of Reviewed Literature

Populations	[Literature ID] Sample Size	# Articles	% of total	# Participants	% of total participants
<u>Non-Clinical</u>					
Adults	[51] [27] 27 15	2	3.6%	42	1.4%
Children	[8] [55] 75 51	2	3.6%	126	4.2%
First Responders	[36] 41	1	1.8%	41	1.4%
Seniors	[21] [25] [32] [33] [36] 31 60 42 60 30	5	8.9%	223	7.5%
University Students	[1] [6] [45] [53] 56 29 10 44	4	7.1%	130	4.4%
Total		**14**	**25%**	**562**	**18.9%**
<u>Clinical</u>					
Cancer	[24] [39] [50] 91 60 184	3	5.4%	335	11.2
Cardiac Patients	[13] [20] [56] 45 58 24	3	5.4%	127	4.3%
Children with Special Needs	[40] 13	1	1.8%	13	0.4%

Depression	[5] 44	1	1.8%	44	1.5%
Fibromyalgia	[42] 20	1	1.8%	20	0.7%
Hemodialysis Patients	[35] 102	1	1.8%	102	3.4%
Insomnia or Poor Sleep Quality	[2] [9] [10] [12] [14] [16] [17] 15 38 38 31 11 30 50 [18] [31] [34] [37] [38] [41] 94 89 71 24 64 43 [44] [47] [49] [52] [54] 61 50 57 38 98	18	32.1%	902	30.2%
Burn Unit Patients	[22] 50	1	1.8%	50	1.7%
Patients in ICU	[19] [11] [15]	3	5.4%	139	4.7%
Pregnant Women	[26] [43] 88 121	2	3.6%	209	7.0%
Premature Infants	[7] [23] [29] 35 30 272	3	5.4%	337	11.3%
PTSD	[4] [46] 15 13	2	3.6%	28	0.9%
Schizophrenia	[3]	1	1.8%	24	0.8%
Seniors with Cognitive Decline	[30] 60	1	1.8%	60	2.0%
Stroke patients	[28]	1	1.8%	30	1.0%
Total		**42**	**75.3%**	**2420**	**81.1%**

Study Design

The study designs of the reviewed articles were thoroughly examined based on the number of groups, the allocation methods, the types of conditions, and the conditions (Table 7). In 45 studies, participants were assigned to more than one group. The most frequently used design was the two-group RCT, using a music group and a no-treatment group as two simple conditions. Some studies also compared the impact of other experimental conditions, such as meditation, with the effect of the music intervention on sleep quality. For studies with only one group, they either did a baseline or a crossover design to assess the outcome of music interventions.

Table 7
Designs of the Reviewed Studies

	Allocation Method	Type of Conditions	Conditions	[Literature ID]
1 Group		Simple	(a) Music	[3, 14, 21, 40, 42, 48]
			(b) Music & massage	[15]
		Crossover	(a) Music, tone, & NT*	[45]

			(b) Lullaby, Gato box, Oceandisc, & NT*	[29]
			(c) Sleep songs, natural sounds, random songs, & NT*	[47]
			(d) Music & NT*	[27]
2 Groups	Randomized	Simple	(a) Music & Antidepressants	[5]
			(b) Music & Meditation	[30]
			(c) Music and sleep hygiene education & just sleep hygiene education	[38]
			(d) Music relaxation & muscle relaxation	[46]
			(e) Music & music with binaural beats	[41]
			(f) Wholetone2Sleep music & classical music	[52]
			(g) Music with mindfulness-based stress reduction & NT*	[24]
			(h) Music & audiobook	[49]
			(i) Music & NT*	[1, 6, 8, 11, 13, 17, 19, 20, 22, 26, 32, 33, 39, 43, 53, 54, 56]
		Crossover	(a) Music & muscular relaxation	[2]
			(b) Music & brisk walking	[9]
			(c)Music & spoken text	[51]
			(d) Music & NT*	[10, 23, 37]
	Assigned	Simple	(a) Music and ergonomic pillow & only ergonomic pillow	[4]
			(b) Participants' brain music & random brain music	[36]
			(c) Music & storytelling	[12]
			(d) Music & NT*	[25]
		Crossover	(a) Lullaby & rain sound	[55]
	Unmentioned	Simple	(a) Music & NT*	[16]
3 Groups	Randomized	Simple	(a) Music, audiobook, & NT*	[18]
			(b) Music and CBT, CBT only, & NT*	[44]
			(c) Music, calligraphy, & NT*	[31]
			(d) Music, music video, & NT*	[34]
			(e) Music during hemodialysis, music before bed, & NT*	[35]
			(f) Recorded lullaby, live lullaby, & NT*	[7]
			(g) Active music therapy, receptive music therapy, & NT*	[50]
	Assigned	Simple	(a) Eastern Turkish Music, western Turkish music, & NT*	[28]

Note. NT* = No-treatment

Measurement of Sleep Quality

The researchers of the reviewed literature employed multifarious methods to measure sleep quality (Table 8). The most prevalent measurement of sleep quality was PSQI (26 studies, 46.4%). Twenty-two studies (39.3%) used more than one method to measure sleep quality. Oxtoby and colleagues (2013) used the largest number of instruments, employing five subjective sleep questionnaires. Sleep questionnaires designed specifically for the study (six studies, 10.7%) and participants' sleep journals (six, 10.7%) were also used.

Table 8
Measurement of Sleep Quality

	Measurement	[Literature ID]
Objective	Observation Checklist	[40, 55]
	Physiological Response	[7, 31*]
	Polysomnography	[10*, 17*, 19*, 37, 45, 49*, 54]
	EEG	[9*, 23, 27, 31*, 34*, 41*, 51*]
	Actigraph	[2*, 3*, 8, 9*, 46*, 47]
	Sleep Pattern Recorded by Nurses	[29]
	Total Number of Sleeping Hours	[20*]
	Urine Analysis	[13*]
Subjective	Sleep Journal	[4*, 34*, 41*, 43*, 51*, 52*]
	Other Standardized Sleep Quality Questionnaires**	[1*, 2*, 3*, 11, 12, 13*, 15, 19*, 20*, 36*, 41*, 42, 46*, 49*, 56]
	Pittsburgh Sleep Quality Index (PSQI)	[1*, 4*, 5, 6, 14, 16, 18, 21*, 22, 24, 25, 26, 28, 30, 32, 33, 35, 38, 39, 43*, 44, 48, 49*, 50, 52*, 53]
	Customized Questionnaires	[9*, 10*, 17*, 21*, 36*, 51*]

Note. * = Studies used more than one measurement of sleep quality; ** = Dysfunctional Beliefs and Attitudes about Sleep Scale [1], GATIA Scale [12], Insomnia Severity Index [41, 49], Jenkins Sleep Evaluation Questionnaire [42], Mini Sleep Questionnaire [2, 3, 46], Pittsburgh Insomnia Rating Scale [36], Pre-Sleep Arousal Scale [1], Richards-Campbell Sleep Questionnaire [11, 13, 15, 56], Sleep Associated Monitory Index [1], Sleep Related Behaviour Questionnaire [1], Technion Long Sleep Questionnaire [2, 3, 46], & Verran and Synder-Halpern Sleeping Scale [19, 20].

Interventions

The researchers used Robb and colleagues' (2010) article as a guideline to examine the music interventions used in the reviewed studies. Non-music interventions were not analyzed.

Intervention Rationale

The reasons for choosing the music were sorted into five categories (Table 9): consultation with musicians or music therapists (five studies, 8.9%), the music was evaluated by a third party before the study (three, 5.4%), participants brought their own music (three, 5.4%), evidence from previous studies (seven, 12.5%), and subjective reasoning (seven, 12.5%)—for example, "The musical pieces are all familiar and have a pleasant sound" (Chang et al., 2012, p. 923). However, a majority of the researchers provided no reason for their music choice (31, 55.4%).

Table 9
Music Selection Rationale

Rationale	[Literature ID]	Number (Percentage)
Consulted musicians/ music therapists	[11, 21, 24, 38, 39]	5 (8.9%)
Evaluated by third party	[1, 4, 35]	3 (5.4%)
Participants' choice	[15, 17, 50]	3 (5.4%)
Previous studies	[20, 32, 33, 43, 49, 51, 54]	7 (12.5%)
Subjective reasoning	[22, 23, 27, 31, 42, 47, 52]	7 (12.5%)
Not specified	[2, 3, 5, 6, 7, 8, 9, 10, 12, 13, 14, 16, 18, 19, 25, 26, 28, 29, 30, 34, 36, 37, 40, 41, 44, 45 ,46, 48, 53, 55, 56]	31 (55.4%)

Genre of the Music

The music used in the interventions was classified into eight genres (Table 10). The most commonly used group was music with strong cultural or religious associations (15 studies, 26.8%). Fourteen experiments (25.0%) used Western music, including classical and jazz. In five studies (8.9%), the music was composed for the experiment. Other genres include lullaby, new age music, pop music, and brain music which was generated based on the participants' brain wave signals (DuRousseau et al., 2011). Ten studies (17.9%) used music from multiple genres. However, in 17 articles (30.4%), the music genre was either not specified or referred to as "sedative music."

Table 10
Genre of Interventions

Genre	[Literature ID]
Brain Music	[36]
Culture/Religious	
Chinese	[13, 17*, 31, 32*, 33*, 38*, 43*]
Buddhist	[9, 10, 34]
Indian (*Raagas*)	[5, 53]

Turkish	[21, 28, 39]
Composed for study	[2, 3, 19, 37*, 46]
Lullaby	[7, 12, 14, 23, 29, 40, 43*, 55]
New Age	[4, 26, 33*, 35, 49*, 54*]
Pop	
Korean Pop Music	[41*, 47]
Persian Pop Music	[50]
Sedative/Not Specified	[1*, 8, 11, 15, 16, 20*, 22, 24, 25, 27, 32*, 37*, 42, 44, 45, 48, 51, 56]
Western	
Classical	[1*, 6, 17*, 18, 20*, 30, 32*, 33*, 38*, 41*, 43*, 49*, 52, 54*]
Jazz	[32*, 33*, 49* 54*]

Note. * = studies used music from more than one genre.

Intervention Description

Most reviewed articles provided details of some aspects of the music used in the interventions (Table 11). The most commonly used instruments were guitar, piano, and voice, (20 studies, 35.7%). The tempo of the music used was usually between 50 and 80 bpm (17, 30.4%). The length of the music was between 10 and 58 minutes (11, 19.6%). Ten studies (17.9%) specified the tonality or scale of the music, including minor, pentatonic, and Turkish scales (*Ussak, Hicaz*, and *Zirefkend*). Ryu et al. (2012) provided detailed information about the order of the music used in their intervention. Bloch et al. (2010) provided a thorough description of the chord progressions and the structure of music. However, 12 studies (21.4%) provided no musical details. For two of those studies, this was because they asked participants to bring their own music.

Table 11
Intervention Descriptions

Music Aspects	[Literature ID]	Number (Percentage)
Artist	[23]	1 (1.8%)
Composer	[11, 18, 20, 22, 23, 26, 30, 35, 49, 51, 52, 54]	12 (21.4%)
Chord Progression	[3]	1 (1.8%)
Dynamics	[3, 4, 19, 38, 39, 49]	6 (10.7%)
Instrument/Voice	[1, 2, 3, 4, 5, 7, 10, 11, 23, 29, 31, 32, 33, 36, 37, 38, 46, 47, 53, 54]	20 (35.7%)
Length	[1, 3, 4, 9, 10, 19, 30, 33, 43, 51, 54]	11 (19.6%)

Music/Album Title	[4, 6, 9, 10, 11, 13, 17, 18, 20, 21, 23, 28, 31, 33, 34, 35, 40, 42, 43, 45, 49, 51, 52, 53, 54, 55]	26 (46.4%)
Rhythm	[7]	1 (1.8%)
Speed/Tempo	[2, 3, 4, 7, 9, 10, 19, 28, 32, 33, 34, 38, 42, 43, 47, 49, 51]	17 (30.4%)
Structure	[3, 4, 20, 49]	4 (7.1%)
Tonality	[2, 9, 10, 19, 21, 34, 37, 39, 46, 47]	10 (17.9%)
Tuning	[27]	1 (1.8%)
No details	[8, 12, 14, 15, 16, 24, 25, 41, 44, 48, 50, 56]	12 (21.4%)

Music Delivery Method

Table 12 summarizes how the music interventions were delivered. Most studies (52, 92.9 %) used only recorded music. Loewy and colleagues (2013) and Uhlig and colleagues (2018) used live music only. Garunkstiene and colleagues (2014) compared live and recorded music. Vinayak and colleagues (2017) compared active music therapy and receptive music therapy interventions. Both headphones/earphones (12 studies, 21.4%) and speakers (eight, 14.3%) were used to play recorded music. Jespersen and Vuust (2012) and Jespersen and colleagues (2019) used a music player specifically designed to be used in bed. Thirty articles (53.6%) did not specify what device participants used to receive the music intervention. Cordi et al. (2019), Garunkstiene et al. (2014), Stokes et al. (2018), and Su et al. (2013) specified the loudness of the music. In the studies by Loewy et al. (2013) and Garunkstiene et al. (2014), music therapists sang and played instruments. In the studies by Uhlig and colleagues (2018) and Vinayak and colleagues (2017), participants were interactively involved in making music with the music therapists.

Table 12
Music Delivery Method

Type	**Device**	**[Literature ID]**
Recorded Music	Earphones/headphones	[11, 13, 15, 16, 20, 31, 32, 33, 35, 41, 42, 53]
	Speakers	[7*L, 28, 39, 45, 51L, 54, 55, 56]
	Specially Designed Equipment	[4, 49]
	Unspecified	[1, 2, 3, 5, 6, 9, 10, 12, 14, 17, 18, 19L, 21, 22, 23L, 26, 27, 30, 34, 36, 37, 38, 40, 43, 44, 46, 47, 48, 50*, 52]
Live Music	By music therapists	[7*, 29]
	Unspecified	[8]

Interactive	Played by participants	[50*]
Unspecified	Unspecified	[24, 25]

Note. L = loudness of music was specified; * = multiple delivery methods

Intervention Schedule

The majority of the interventions were conducted at bedtime (34 studies, 60.7%). In the studies by Mottaghi et al. (2015) and Hu et al. (2015), the interventions were carried out both at night and in the morning. Cordi et al. (2019), Dubey et al. (2019), Hansen et al. (2017), and Patterson (2011) conducted the intervention at naptime. Fifteen studies (26.8%) did not specify when the interventions were given to participants (Table 13).

Table 13
Intervention Schedule

Intervention Time	[Literature ID]	Number (Percentage)
During medical treatment	[28, 35*]	2 (3.6%)
Naptime	[11, 27, 51, 55]	4 (7.1%)
Night (bedtime)	[1, 2, 3, 4, 5, 6, 9, 10, 12, 14, 15, 16, 17, 18, 19, 20, 21, 22, 31, 34, 35*, 37, 38, 39, 40, 41, 42, 43, 45, 47, 49, 52, 54, 56]	34 (60.7%)
Night and morning	[13, 44]	2 (3.6%)
Not specified	[7, 8, 23, 24, 25, 26, 29, 30, 32, 33, 36, 46, 48, 50, 53]	15 (26.8%)

Note. * = different conditions received music intervention at different times

Durations and Number of Treatments

How much treatment each of the participants received varied greatly across the reviewed studies and was demonstrated by the durations and number of treatments (Table 14). The shortest treatment was 10 minutes (Loewy et al., 2013). The longest intervention was six hours (Stokes et al., 2018). The number of interventions was calculated by using the treatment frequency and the entire treatment period. The highest number of treatments was 90 (Wang et al., 2016). In 11 articles (19.6%), participants received the music treatment only once. Four articles (7.1%) only specified the number of treatments. Two articles (3.6%) provided no information on either the duration or the number of treatments.

Table 14
Intervention Durations and Number of Treatments

Duration / #Treatments	1-15 mins	16-30 mins	31-60 mins	60+ mins	Not specified
1	[51]	[10, 11, 27, 54]	[19, 37]	[15, 23]	[45, 56]
2-5		[7, 9, 12, 13, 32, 34, 55]	[16, 17, 22]		
6-10	[29]	[24, 10, 50, 52]	[2, 3, 28, 33, 40, 46]	[39]	
11-20		[1, 41, 43]	[8, 35*, 47]		
21-40		[14, 31, 53]	[4, 5, 6, 18, 20, 21, 26, 35*, 44, 49]		[25, 42]
41-100	[30]		[38]		
Not specified					[36, 48]

Note. *12 treatments for music during hemodialysis condition, 28 treatments for music before bed condition

Results Identified in the Literature

The results of the reviewed articles varied (Table 15). Forty-two studies found a significant positive influence of music on sleep quality. Six studies found music had a positive but non-significant effect. Four studies reported music listening had significant positive impacts when using subjective sleep quality measurements but only positive trends when measuring sleep quality objectively. Four studies found music had no influence on young adults with no sleep disorders (Koenig et al., 2013; Lazic & Ogilvie, 2007), adults with PSQ (Kolesnik, 2014), and preschool-aged children (Patterson, 2011). Seven articles (12.5%) compared the effect of music interventions and other treatments on sleep quality. Listening to music was found to be more efficient than muscular relaxation for seniors (Ziv et al., 2008) and people with PTSD (Blanaru et al., 2012); more efficient than brisk walking for seniors with insomnia (Huang et al., 2016); and as effective as antidepressants for patients with depression (Deshmukh et al., 2009), meditation for seniors with cognitive decline (Innes et al., 2016), storytelling for children in hospital (Anggerainy et al., 2019), and calligraphy lessons for adults with insomnia (Fung et al., 2019).

Table 15
Result Categories

Result Categories	[Literature]
Significant positive effect of music on sleep quality	[2*, 3, 4, 5*, 7*, 9*, 11, 12*, 13[S], 14, 15*, 16, 17*, 18, 19, 20, 21, 22, 23, 24*, 25, 26, 29, 30*, 31*, 32, 33, 34[S], 35, 36, 37, 38, 39, 40, 42, 43, 44*, 46*, 47*, 48, 49[S], 50*, 51[S], 52*, 53]
Trend of positive effect of music on sleep quality	[1, 8, 10, 13[O], 27, 28*, 34[O], 41*, 49[O], 51[O], 56]
No effect of music on sleep quality	[6, 45, 54, 55]

Compared different types of music	[17*, 28*, 41*, 47*, 52*]
Compared live and recorded music	[7*]
Compared active and receptive music therapy interventions	[50*]
Music compared to other treatments on sleep quality	[2*, 5*, 9*, 12*, 30*, 31*, 46*]
Combined music and other treatment	[15*, 24*, 44*]

Note. * = studies that fit into multiple categories; ^{S} = results of subjective measures; ^{O} = results of objective measure

Three studies examined the efficacy of combining music listening and other interventions. Mottaghi et al. (2015) suggested that combining music therapy and CBT was more effective at reducing seniors' insomnia than just CBT. Pagnucci and colleagues (2019) reported that listening to music while receiving a massage improved ICU patients' sleep quality. Liu and colleagues (2019) found listening to music followed by mindfulness-based stressed reduction sessions improved the sleep quality of patients with osteosarcoma.

Garunkstiene and colleagues (2014) compared the effect of listening to live and recorded music and found that premature infants had deeper sleep when listening to live lullabies sung by a music therapist. Vinayak and colleagues (2017) found that compared to receptive music therapy interventions, active music therapy interventions were more effective at improving the sleep quality of cancer patients.

Five studies compared the effect of different types of music on sleep quality. Huzmeli and colleagues (2018) found that for stroke patients, listening to western Turkish music during rehabilitative exercise had a stronger impact on sleep quality than eastern Turkish music. Bang and colleagues (2019) found that listening to music with binaural beats improved the sleep quality of adults with insomnia more than listening to music alone. Hausenblas and colleagues (2019) found listening to Western classical music and Wholetones 2Sleep music improved the sleep quality of adults with insomnia. Lee and colleagues (2019) analyzed the impact of listening to different pop songs on the sleep quality of healthy young adults and found tempo was the most important factor that determined whether the music was beneficial. Chang and colleagues (2012) found no differences in the sleep quality between participants who listened to their own music and participants who listened to music chosen by the researchers.

Nine studies (16.1%) reported different types of between- or within-group effect sizes of music interventions on sleep quality of different measurements (Table 16). According to the benchmarks for different types of effect size (Draper, 2020), the results range from small to large. The authors calculated the within-group effect size of the 21 studies (37.5%) that reported the pre- and posttest PSQI scores and standard deviations (Figure 3). The authors found 14 studies (66.7%) had a large effect size ($d \leq -0.8$), six studies (28.6%) had a medium or a small effect size ($-0.8 < d < 0$), and one study (4.8%) had no effect ($d \geq 0$). Overall, participants' sleep quality improved significantly after receiving music interventions ($d = -1.28$; 95% CI: -1.55 to -1.11; $Z = 9.27$, $p < .00001$).

Table 16
Reported Effect Size

[ID]	Measurement	Type of Effect Size	Effect Size	
[1]	PSQI^B	rank-biserial correlation	r = -.161	small
[8]	Sleep time^B	partial eta squared	$\eta^2 = 0.05$	medium

[29]	Positive sleep pattern recorded by nurses (Ocean drum)^W	Cohen's d	d = 0.26	small
	Positive sleep pattern recorded by nurses (gato box)^W	Cohen's d	d = 0.11	small
[30]	PSQI^W	Cohen's d	d = 0.5	medium
[38]	PSQI^B	partial eta squared	$\eta^2 = 0.17$	large
[41]	ISI^W	Cohen's d	d = 1.02	large
[43]	PSQI^B	Cohen's d	d = -0.36	medium
[45]	PSG (sleep onset latency)^B	Hedges's g	g=0.38	medium
	PSG (percent slow wave sleep)^B	Hedges's g	g= 0.11	small
[49]	ISI^W	Cohen's d	d = 0.71	medium
	PSQI^W	Cohen's d	d = 0.77	medium

^B = between-group calculation; ^W = within-group calculation

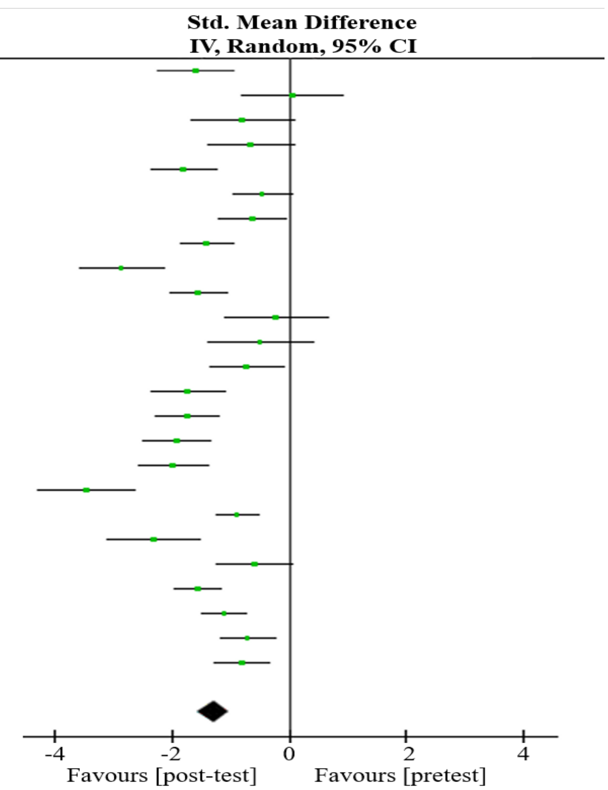
Figure 3

Forest Plot of Effect Sizes for Studies that Used PSQI as an Outcome

Study or Subgroup	Weight	Std. Mean Difference IV, Random, 95% CI
[5]	3.9%	-1.60 [-2.25, -0.94]
[6]	3.3%	0.06 [-0.82, 0.93]
[14]	3.3%	-0.80 [-1.68, 0.08]
[16]	3.7%	-0.66 [-1.39, 0.08
[18]	4.2%	-1.81 [-2.37, -1.24]
[21]	4.3%	-0.46 [-0.96, 0.05]
[22]	4.2%	-0.62 [-1.19, -0.05]
[24]	4.4%	-1.40 [-1.86, -0.94]
[25]	3.7%	-2.86 [-3.59, -2.13]
[26]	4.4%	-1.55 [-2.03, -1.06]
[28] Eastern Turkey Music	3.3%	-0.23 [-1.11, 0.65]
[28] Western Turkey Music	3.3%	-0.49 [-1.38, 0.40]
[32]	4.0%	-0.73 [-1.35, -0.10]
[33]	4.0%	-1.73 [-2.35, -1.11]
[35] music before bed	4.2%	-1.74 [-2.30, -1.19]
[35] music during hemondialysis	4.1%	-1.93 [-2.50, -1.35]
[38]	4.1%	-1.98 [-2.59, -1.38]
[39]	3.5%	-3.46 [-4.28, -2.65]
[43]	4.6%	-0.89 [-1.25, -0.52]
[44]	3.6%	-2.32 [-3.10, -1.54]
[49]	3.9%	-0.59 [-1.25, 0.07]
[50] active music therapy	4.6%	-1.56 [-1.97, -1.15]
[50] receptive music therapy	4.6%	-1.11 [-1.49, -0.73]
[52] Classical Music	4.4%	-0.71 [-1.17, -0.24]
[52] Wholetone2Sleep	4.4%	-0.80 [-1.27, -0.33]
Total (95% CI)	**100.0%**	**-1.28 [-1.55, -1.01]**

Heterogeneity: $Tau^2 = 0.38$; $Chi^2 = 132.99$, df = 24 ($P < 0.00001$); $I^2 = 82\%$

Test for overall effect: Z = 9.27 ($P < 0.00001$)



Discussion

Can Music Interventions Be Used to Improve Sleep Quality?

A majority of the studies reported participants' sleep quality improved after receiving the music interventions. However, due to the wide range of populations studied and the different ways of measuring sleep quality, it is important to discuss whether music interventions can improve sleep quality in specific contexts.

Insomnia

Unsurprisingly, people with insomnia or PSQ were the most explored population. According to the findings, people with insomnia or PSQ, regardless of whether they are young adults (Chen et al., 2014), adults (Chang et al., 2012), or seniors (Fung et al., 2019), can benefit from music interventions. However, Kolesnik (2014) found that music had no effect on sleep quality. There are two potential reasons for this. First, Kolesnik (2014) was investigating the first night effect of participants in a sleep lab. Participants may have felt abnormally anxious because of the unfamiliar environment and wearing uncomfortable medical equipment. Therefore, these findings are not generalizable to more common situations. Second, the participants received 30 minutes of music listening only once. More research is needed to investigate whether long-term music interventions can benefit participants in sleep labs.

Other Clinical Populations

Fourteen other clinical populations were investigated in 24 studies. Based on the number of studies per population, none of these populations were examined as thoroughly as those with insomnia or PSQ. However, all of the studies done on these clinical populations reported significant positive results (22 studies, 91.7%) or a positive trend (two studies, 8.3%) (see Tables 6 and 15). The results provide strong evidence that clinicians should consider music interventions when sleep quality is vital for patients' healing processes. One possible reason these studies have similar results is, although the participants suffered from different ailments, they may have had trouble sleeping for similar reasons, such as pain, stress, or other mental or physical symptoms. Researchers can continue to conduct studies to explore how music interventions affect the sleep quality of specific populations and why music can reduce sleep problems associated with certain symptoms in general.

Non-Clinical Populations

All five articles that studied seniors found that music had a significant positive effect regardless of whether they lived in a nursing home (Altan Sarikaya & Oguz, 2016; Chan et al., 2010; Hemavathy & Muthamizh Selvan, 2016; Kumar et al., 2019) or in the community (Shum et al., 2014). When studying young adults, the results were mixed. Sharma and Sharma (2015) showed that listening to sedative music significantly improved the sleep quality of Indian university students. Oxtoby and colleagues (2013) found that only factors that theoretically influence sleep quality, but not the measurement of sleep quality itself, were significantly improved. Koenig and colleagues (2013) and Lazic and Ogilvie (2007) both found that listening to music had no impact on the sleep quality of young adults.

Patterson (2011) found that neither lullabies nor rain sounds improved the sleep quality of pre-school aged children. Uhlig and colleagues (2018) found participating in rap & sing music therapy did not significantly improve the overall sleep quality of adolescents. However, the total sleep time of the participants in the intervention group declined less over the course of the study than that of the control group.

Based on the reviewed studies, it seems seniors can benefit from music listening more than young adults and children. This could be because seniors tend to have lower sleep quality to start with (Ziv et al., 2008). More research needs to be done to explore the effects of music on the sleep quality of non-clinical populations of different ages to provide clearer and more reliable guidelines for sleep quality optimization.

Impact of Different Types of Measurements

Different types of measurements were employed to assess various aspects of sleep quality subjectively and objectively (see Table 8). While music interventions were found to have a positive impact on sleep quality, the significance levels of the findings differ (see Table 15). Of 31 studies that used only subjective measurements, 27 (87.1%) reported significant positive results, three (9.7%) reported a positive trend, and one (3.2%) found no effect. Of 12 studies that used objective measurements only, six (50.0%) reported significant positive results, three (25.0%) reported a positive trend, and three (25.0%) found no effect. Four studies (Cordi et al., 2019; Hu et al., 2015; Huang et al., 2017; Jespersen et al., 2019) that used both subjective and objective sleep quality measurements found significant positive results for the subjective data and only positive trends for the objective data. It seems the subjective studies had a better chance of finding a significant positive result than the objective studies. This raises two questions: Which type of sleep quality measurement is more reliable? Is it more important for people to believe they sleep well or to be observed having a good sleep quality? More research can be done to explore these questions.

Because of the nature of music interventions, the inability to blind the participants to their condition may influence their answers for the subjective measurements. However, a majority of the reviewed studies used subjective measurements, possibly because of the cost of objective measurements. Another disadvantage of using objective measurements is some equipment (e.g., EEG) may decrease the participants' level of comfort while sleeping. To address this, some researchers used wearable actigraph devices to measure sleep quality (Lee et al., 2019; Uhlig et al., 2018).

Effect Size of the Studies

Although effect size is known for facilitating the interpretation of the therapeutic effects of music therapy studies (Gold, 2004), it was only reported in nine reviewed studies. The wide range of measurements and different ways researchers chose to calculate effect sizes also made it hard to compare the effect sizes reported in the reviewed studies. With the intention of examining the effect size of different studies using the same sleep quality measurement, the authors calculated Cohen's *d* of 21 studies in which the PSQI was used. Although an overall large effect size was found, the range of the effect size of each individual study was wide (-3.46 to 0.06) (see Figure 3).

Future researchers should carefully consider the population and the details of the music intervention used to estimate the effect size for their study. If future researchers plan to use the PSQI as the sleep quality measurement, they can use this review as a resource to estimate the effect size. The authors recommend future researchers also report the effect sizes in their studies.

What Music Interventions Can Be Used to Improve Sleep Quality?

In most of the reviewed studies, researchers used receptive music interventions to improve participants' sleep quality. This may be because the purpose of the music is to calm participants rather than engage them in the music-making process. Diverse types of music were used in these studies.

Cultural and Religious Music

Many studies suggested that music that matched participants' cultural background—such as Chinese music (Fung et al., 2019), Indian music (Deshmukh et al., 2009), Turkish music (Lafçi & Öztunç, 2015), and

Western music (Hausenblas et al., 2019)—or their beliefs—such as Buddhist music (Lai et al., 2015)—could help them sleep better. The fact that all of the participants in these studies were adults may indicate that familiarity is an important factor to consider when choosing music for a sleep-inducing intervention. Clinicians should carefully assess clients' cultural and religious backgrounds in their practice.

Lullabies

The studies involving premature infants (Garunkstiene et al., 2014; Loewy et al., 2013), children with special needs (Gonzales, 2013), and children in a daycare (Patterson, 2011) used lullabies as the music intervention. The sleep quality of other populations may benefit from lullabies as well. Street and colleagues (2014) found that an arrangement of lullabies and heartbeat sounds helped adults with insomnia sleep better. Liu and colleagues (2016) used a variety of musical styles, including lullabies, to improve pregnant women's sleep quality. The effectiveness of lullabies may be because the participants may associate lullabies with sleep. The common musical characteristics of lullabies (slow tempo, small dynamic range, and simple melody) may also contribute. More research needs to be done to discover whether listening to lullabies is an effective way to improve the sleep quality of other adult populations.

Other Genres

Other genres, such as new age music (Shum et al., 2014) and sedative music (Hausenblas et al., 2019), were also used. Although the definitions of these music genres are unclear, they often have musical characteristics similar to music from previously mentioned genres, such as slow tempo and a limited range of pitch and dynamics.

Therefore, when clinicians look for music to improve sleep quality, analyzing the musical characteristics—such as tempo, dynamics, tonality, and the melodic, harmonic, and structural complexity—may be more informative than merely choosing music based on the genre. These features can also serve as guidelines for composing or improvising music for improving sleep quality, as seen in Bloch et al. (2010), Su et al. (2013), and Ziv et al. (2008).

Brain Music

DuRousseau and colleagues (2011) reported that brain music significantly improved first responders' sleep quality. Brain music, generated with the EEG signals of one's brain waves, was first proposed by Levine et al., (1991) as a treatment for insomnia, anxiety, and depression. With the development of neuroscience and computer science, more research can be done to reveal the mechanism, composing process, and effects of brain music on sleep quality.

Live versus Recorded Music

Garunkstiene et al. (2014) and Loewy et al. (2013) reported that listening to live music can help premature infants sleep better. Garunkstiene et al. (2014) found that live music was more successful at enhancing the babies' sleep quality than recorded music. Loewy et al. (2013) compared three types of live music interventions and found an ocean disc improvisation improved premature infants' sleep quality the most. Compared to recorded music, the biggest advantage of listening to live music provided by a music therapist is that features of the music—like speed, volume, and dynamics—can be adjusted in real time according to the participant's reactions. Although a positive effect was found for listening to live music, both studies had premature infants as the participants. This may be because using music therapy in the Neonatal Intensive Care Unit (NICU) is an established practice (Standley, 2012). A possible reason for the lack of literature studying live music interventions with older populations is they may be more concerned with privacy and may feel uncomfortable having an unfamiliar person present when they are falling asleep. However, this modality may be beneficial to investigate within older populations.

It may be worth exploring how to make recorded music interventions adjustable according to a participant's physical changes. Just like how brain music is generated with EEG signals (DuRousseau et al., 2011; Levine et al., 1991), real-time feedback technology could be involved to monitor physiological responses to the music and use those responses to adjust aspects of the music (e.g., the tempo of the music could match changes in participants' breathing patterns).

Active versus Receptive Music Interventions

Uhlig and colleagues (2018) found that using only an active music intervention (rap & sing music therapy) had a positive but not significant effect on the sleep quality of adolescents. Vinayak and colleagues (2017) found both active and receptive music interventions had a significant positive impact on the sleep quality of patients undergoing cancer treatment; however, the active music intervention was more effective. Vinayak and colleagues (2017) may have found a significant effect, whereas Uhlig et al. (2018) did not because the adolescents did not have sleep disturbances, so their sleep quality may not have been able to improve as much as the cancer patients' sleep quality. Another possible reason is that Vinayak et al. (2017) used a subjective sleep questionnaire (the PSQI) whereas Uhlig and colleagues (2018) used an objective sleep measurement (the actigraph). More research may be done on the role of active music interventions in promoting sleep quality.

Other Aspects of the Interventions

Other than what music was used, the authors also analyzed how other aspects of the interventions (e.g., how the music was chosen and delivered, what time the participants received the interventions, and how many were provided) influenced the study results. However, the only finding is that receiving a certain number of music intervention treatments may be necessary for a significant impact on sleep quality to emerge. In order to develop a practical guideline for practitioners to follow when designing sleep-quality-related music interventions, cross-study analysis needs to be done to find the ideal music intervention protocol for different populations. Unfortunately, most reviewed articles did not provide enough details to support this kind of analysis. Therefore, the authors suggest future researchers use Robb et al. (2010) as a guideline to report music-based interventions to provide a more comprehensive description of how the interventions were designed and applied.

Music Interventions Compared with Other Interventions

In clinical practice, many pharmacological and non-pharmacological treatments have been used to help patients sleep. It is important to compare the effect of music interventions and other treatments on sleep quality to find the ideal treatment strategy. Seven reviewed studies (Blanaru et al., 2012; Deshmukh et al., 2009; Fung et al., 2019; Huang et al., 2016; Innes et al., 2016; Mottaghi et al., 2015; Ziv et al., 2008) explored this area and indicated that music interventions have an effect comparable to some other treatments, including a certain dosage of antidepressants (Deshmukh et al., 2009). Considering music interventions typically have no side effects yet influence sleep quality, more research can be done to identify the ideal strategy to improve sleep quality by comparing music interventions and other treatments or using music interventions to complement other treatments.

Clarifying the Term "Music Therapy" in Research

According to the Canadian Association of Music Therapists (CAMT) (n.d.) website, one of the key elements of music therapy is the involvement of a certified music therapist. However, as stated in the World Federation of Music Therapy's definition of music therapy, "Research, practice, education, and clinical training in music therapy are based on professional standards according to cultural, social, and political contexts" (Kern, 2011, para. 3). Although most reviewed articles (44, 78.6%) mentioned music therapy or considered their interventions to be music therapy, only nine (16.1%) of them were authored by music therapists (e.g., Jespersen et al., 2019) or had clarified the involvement of music therapists in the study (e.g., Chen et al., 2014) (Table 17). To avoid confusion about the term "music therapy," the authors suggest future researchers define music therapy and music therapists' roles in their study or use other terms, such as "music medicine" or "music interventions" (Bradt et al., 2014; Yinger & Gooding, 2015).

Table 17
Self-Considered Music Therapy Literature

Section	[Literature ID]
Title	[8*, 12, 16, 21, 22, 24*, 25, 26, 28, 29*, 44*, 48, 50*, 53, 54]
Abstract	[8*, 10, 12, 16, 21, 22, 24*, 25, 26, 29*, 36, 39, 40, 44*, 45, 48, 50*, 53, 54, 55]
Keyword	[1, 7*, 8*, 12, 16, 21, 24*, 25, 26, 29*, 43, 44*, 45, 48, 50*, 53],
Introduction	[1, 3, 5, 6*, 7*, 8*, 9, 10, 12, 14, 16, 17, 20, 21, 22, 24*, 25, 26, 27, 29*, 30, 31, 32, 35, 37*, 38, 39, 40, 44*, 46, 48, 50*, 53, 54, 55, 56]
Method, result, & discussion	[7*, 8*, 12, 13, 15, 16, 18, 19, 21, 22, 24*, 25, 26, 27, 28, 29*, 30, 32, 36, 39, 40, 43, 44*, 45, 48, 50*, 53, 54]
Not mentioned	[2, 4*, 11, 23, 33, 34, 41, 42, 47, 49*, 51, 52]

Note. * = studies involving music therapists

Strengths and Limitations

The current review sought to include a wide range of populations and music intervention types. The comprehensive analysis of the music interventions of the reviewed research make this study a valuable resource for researchers and practitioners to consult when designing music interventions for improving sleep quality. Nonetheless, limitations exist.

Firstly, due to the authors' lack of knowledge of other languages, only English articles published between January 2007 and December 2019 were included. Secondly, only articles focused on sleep quality were reviewed. Some studies that focused on the effects of music interventions on other clinical symptoms, like trauma (Beck et al., 2018), stress (Beck et al., 2015), and cognitive decline (Innes et al., 2018), also measured sleep quality. Although these studies were excluded from the review, they may offer insight into using music interventions to improve sleep quality. Thirdly, the researchers have limited knowledge of music from cultures other than Western and Chinese, such as Indian and Turkish music, which may have led to a misunderstanding when reviewing those music interventions.

Conclusion

There is a growing interest in the impact of music on sleep quality. The reviewed articles indicated that music interventions can be used to enhance the sleep quality of various clinical and non-clinical populations. A comprehensive analysis of music interventions was conducted to find out how music can be used to improve sleep quality. The comparison of the effect on sleep quality between music and non-music interventions, between live and recorded music, and between active and receptive music interventions was reviewed and synthesized. The results can be used as evidence of the efficacy of music interventions to treat sleep disorders. The authors hope this review can serve as a guide for music therapists to develop interventions to help clients from different populations improve their sleep quality. In order to develop these guidelines further, music therapists can work towards compiling a database of music that can be used to improve the sleep quality of various populations. Such a database could be used as a resource for other health professionals who regularly need to help patients or clients improve their sleep quality. Music therapists can work as consultants for studies on the impact of music interventions on sleep quality, and more research can be done to investigate the effects of various active and live music interventions for sleep quality.

Acknowledgments

Part of this study was completed in partial fulfillment of the first author's Master's degree at Concordia University, Montreal, QC. The authors wish to thank Dr. Sandra L. Curtis, Dr. Guylaine Vaillancourt, and Dr. Laurel Young for their inspiration and sharing of their expertise.

Conflict of interest: None declared.

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