



Effect of Music Therapy on Oxygen Saturation Level: A Literature Review

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Abstract

Music therapy as a non-invasive therapeutic modality is gaining prominence worldwide both in hospital settings as an adjunct therapy as well as for community wellbeing. Music therapy offers encouraging evidence-based outcomes for stabilising vital parameters to improve symptoms associated with complex illnesses such as autism spectrum disorder or major depressive disorders. The purpose of this review is to 1) identify scientific literatures that offer insights on the effect of music therapy on oxygen saturation levels of patients undergoing treatments for diverse conditions; 2) compare the effects of music therapy based on identified parameters 3) analyse the critical reviews of the researchers of studies included in this literature scan and 4) synthesise the review findings for the benefit of future scientific researches on the effect of music therapy on oxygen saturation levels. In this review, an analysis of relevant scientific papers published in the last 80 years from 1940 to 2020 (as available) was done by searching databases such as PubMed, Cochrane Library, Wiley Online Library, Gray Literature sources such as Google Scholar, Worldcat; DOAJ, and WHO Global Index Medicus. Eighteen relevant papers describing music therapy's effect on the patient's oxygen saturation levels (under different conditions) were included in the review. The results and discussions respectively compare and analyse characteristics of included studies, music therapy administered, measuring device used, the effectiveness of music therapy on oxygen saturation levels, and critical reviews of authors of the scanned literature.

Keywords: music therapy, oxygen saturation level, SpO₂, SaO₂

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INTRODUCTION

Music therapy is considered to be one of the best alternative, adjunct, and non-invasive therapeutic measures worldwide for alleviating diverse conditions/symptoms of diseases and disorders. As a natural therapeutic and healing modality, researchers and scientists are conducting numerous experiments to assess the benefit of music therapy in neurological,

psychological, physiological, and other areas. It has become a norm to measure and maintain a normal oxygen saturation level, especially during the pandemic when oxygen saturation is being used as a marker of fatality for Covid-19-affected patients (Mejía F et al., 2020). A pulse oximeter (oximeter) has entered every home, and people are more conscious than before about their oxygen uptake and saturation; and how they breathe. At the same time,

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people's reliance on natural therapies to improve oxygen saturation level and uptake has increased significantly. Music therapy is one such therapeutic measure accepted well across the globe. The effect of music therapy on diverse conditions has been studied for the past many years. There is a body of evidence-based scientific research where music therapy has shown efficacy in improving conditions, disorders, and symptoms. Music therapy has been used for acute stroke rehabilitation (Alexander Street et al., 2020); to bring positive changes in cognitive, psychological (anxiety, depression), and behaviour aspects for patients having Alzheimer's disease (Gómez Gallego M et al., 2017); in lowering anxiety and distress of cancer patients during simulation procedure for radiation therapy (Andrew Rossetti et al., 2017); in better social skill developments, mood, language, sensory perception and behaviour in individuals having autism spectrum disorder (Zhi-Min Shi et al., 2016) and for other symptom improvements. Further research focuses on permanently damaging the Coronavirus shell with ultrasound vibrations at frequencies between 25 megahertz to 110 megahertz (Wierzbicki T et al., 2021). These frequencies for collapsing viral shells and damaging vibration of viral spikes are routinely used in medical imaging diagnostics. As a natural and non-invasive intervention, the impact of music therapy on oxygen saturation levels is studied for patients suffering from diverse conditions or undergoing treatments for some diseases.

Oxygen saturation is a key parameter in determining blood oxygen content as well as oxygen delivery. Oxygen saturation is the measure of the proportion of oxygen attached to haemoglobin in the blood (that is, oxyhaemoglobin), estimated as a percentage. Oxygen saturations are abbreviated SpO₂/ SaO₂ (for arterial saturation) or SvO₂ (for venous saturation). SpO₂/ SaO₂ is generally measured with a pulse oximeter as a clinically acceptable standard monitoring modality to assess oxygen sufficiency in clinical settings and also at home setups (Andrew B. Lumb et

al., 2019). The normal SpO₂/ SaO₂ level is 95% - 100% in healthy adults.

The prevalent disorders and symptoms affecting respiratory system functioning, unstable oxygen saturation, oxygen uptake, lower oxygen saturation level in Covid-19 patients, etc., have accentuated increased employment of natural modalities. These eventually help improve SpO₂/ SaO₂ - whether in clinical setup, home setup, or in rehabilitation procedures. Considering music therapy as a natural therapeutic modality, studies have shown increased SpO₂/ SaO₂ for patients under different conditions and medical care. Examples include women undergoing caesarean delivery (Handan E et al., 2018), patients undergoing open-heart surgery (Nilsson U, 2009), or babies in a neonatal intensive care unit (NICU) (Berna Alay et al., 2019). Studies have also shown no effect of music therapy in certain cases where the duration of therapy was less (Dixit UB et al., 2020) or for postoperative patients who underwent hernia repair (Nilsson U et al., 2005).

Thus, in view of all the above aspects, it becomes relevant to find out what the recent literature narrates about the impact of music as a therapeutic modality on the oxygen saturation levels of patients undergoing treatments. At the same time, the purpose of the literature scan is also to ascertain whether music therapy can be considered a modality for improved oxygen saturation levels. Therefore, the literature review was carried out with the objective of addressing the questions: 'can music therapy be administered for patients having challenges with oxygen saturation level?' and 'can music therapy be an effective natural therapy for improving patients' oxygen saturation level?'

Thus, this literature review aims to identify existing research papers that narrate whether music therapy has any effect on vital parameter oxygen saturation levels of patients undergoing treatments for diverse conditions. The further objective is to compare and analyse the findings and critical reviews/ reflections of authors of

scanned literature and synthesise from those for widening the application of music therapy in future research works to assess its effectiveness on oxygen saturation levels.

METHOD

Search Strategy

A literature review was thus a logical progression to explore the purpose at hand and to find answers to the questions recounted above. Databases searched for the review of literature are PubMed (Jan 1940 – Dec 2020), Cochrane library (Jan 1947 – Dec 2020), Wiley Online Library (Jan 2004 – Dec 2020), Gray Literature sources such as Google Scholar (Jan 1940 – Dec 2020), Worldcat (Jan 2011 – Dec 2020); DOAJ (Jan 2012 – Dec 2020) and WHO Global Index Medicus (Jan 1940 – Dec 2020) with the keywords ‘music therapy’, ‘oxygen saturation level’, ‘SpO2’ and ‘SaO2’. Filter was applied for 1940–2020 as applicable for different databases. All relevant and original full-text articles that matched the search criteria of the effect of music therapy on oxygen saturation levels were included.

Selection Criteria

The selection criteria of the studies in the literature review were based on the following aspects:

Inclusion criteria were 1) original research papers published in the last 80 years (1940-2020) in peer-reviewed journals that report the effect of music therapy on the oxygen saturation level of a diverse group of patients; 2) the papers where the parameter was independently measured; 3) included full-text papers and 4) papers that were written in English. Papers excluded were 1) review papers; 2) thesis, 3) ongoing clinical trials, and 4) papers without any outcomes concerning oxygen saturation level as a result of music therapy intervention. No other criteria were applied for the search of the literature in this review.

RESULT AND DISCUSSION

Results

Characteristics of the included studies

In total (n=321) unfiltered/ raw papers were found during the first phase of the literature search within the databases PubMed (33); Cochrane (47); Google Scholar (172); Wiley Online Library (49); Worldcat (12); DOAJ (5) and WHO Global Index Medicus database (3) (Figure. 1). Taking into consideration the objective of this literature review, the emphasis was to identify which of these (n=321) papers focus precisely on reporting any effect of music therapy on oxygen saturation levels of respective participant groups. Removal of duplicate records resulted in (n=284) papers. Through preliminary screening, records remained (n=93), which offered focused reporting of the impact of music therapy on oxygen saturation levels. Further screening resulted in (n=30) full-text articles. Final cleaning was applied in the analysis of the literature review scan when review papers and papers reporting no study results were removed; this resulted in (n=18) papers, which were included for review. Close scrutiny of these eighteen literature-scanned papers helped compile study details, music type used in therapy, and study conclusions. The results are presented in Table 1.

Eighteen studies included in the literature review have varied numbers of participants ranging from 26 to 202. 50% of the studies have less than 50 participants, while the rest 50% reported over 50 participants. Three studies (20% of the total) reported participants to be more than or equal to 100. Eight (44.4%) included studies are randomised control trials; five (27.8%) are experimental studies; the remaining five (27.8%) are quasi-experimental, pre and post-test, and single-group randomised clinical trial studies. Adults (n=6; 33.3%) and preterm/ premature infants (n=6; 33.3%) constituted 66.7% of the studies, children and adolescents (n=5) held 27.8% of studies; while one study was conducted with full-term newborns (n=1; 5.5%). For assessing the efficacy of music

therapy on oxygen saturation level, most of the adult studies (66.7%) (Handan E et al., 2018; Nilsson U, 2009; Nilsson U et al. 2005; Saritas et al. 2016) were concerned with pre- intra- and post-operative procedures while other two papers addressed terminally ill patients (Antoniazza B et al., 2018) and ICU patients with head injury (Indriani, N. at al., 2018); three research papers (Dixit UB et al., 2020; Marwah N et al., 2005; Tshiswaka SK et al., 2020) concerning children and adolescents recounted using music therapy pre-, intra- and post-treatment for dental anxiety while two studies (Calcaterra, Valeria et al., 2014; Atiye Karakul et al., 2018) used the music during the recovery period after daycare surgery.

For studies with full-term/ preterm/ premature, predominantly (66.7%) (Berna Alay et al., 2019; Eskandari N et al., 2013; Cristiane Aparecida Moran et al., 2015; Jabraeili M et al., 2016; Elham Shafiei et al., 2020) the effect of music on physiological parameters including oxygen saturation level was measured; two (33.3%) studies (Diler Aydin et al., 2012; Aydın, D. et al., 2014) reported assessing the effect of music therapy on stress too along with oxygen saturation levels.

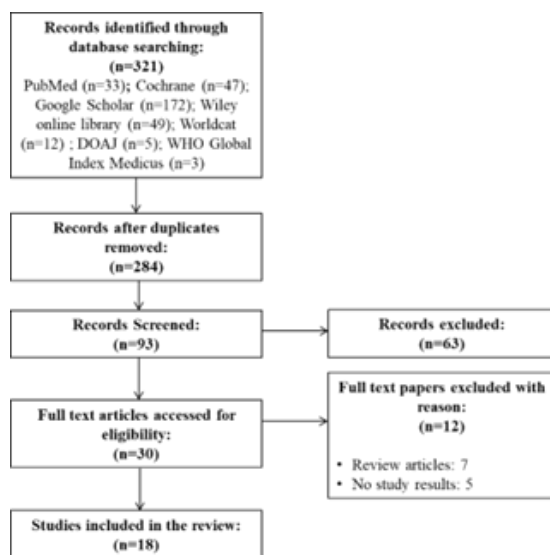


Figure 1. Database record search and selection from PubMed; Cochrane Library; Google Scholar, Wiley Online Library, Worldcat, DOAJ, and WHO Global Index Medicus

Characteristics of music therapy administered

Types and forms of music administered varied across studies, and few papers reported using multiple genres of music in both vocal and instrumental modes. Ten papers used only instrumental music, five used only vocal music, and three reported using both types. Western classical music, lullaby, and Turkish music dominated the music genres used as therapy. Other music used includes popular live music, soft melodies, nature's sound, favourite/ preferred songs/ music choice of participants, Indian classical music, etc. Classical music dominated the music genres chosen for music therapy as per the present literature scan that included western classical music (7), Turkish classical music (2), and Indian classical music (1) forms. In papers using western music therapy, two studies each reported using recorded classical music rendition of Bach (Saritas et al., 2016; Atiye Karakul et al., 2018) and Mozart (Berna Alay et al., 2019; Indriani, N. et al., 2018); two studies used 'New Age' (Nilsson U et al., 2005; Cristiane Aparecida Moran et al., 2015) while another study used classical music rendition of Bach, Mozart, Vivaldi, A. Corelli and E. Grieg Holberg (Calcaterra, Valeria et al., 2014). Four studies used lullabies as therapeutic music (Berna Alay et al., 2019; Eskandari N et al., 2013; Cristiane Aparecida Moran et al., 2015; Elham Shafiei et al., 2020). Cristiane Aparecida Moran et al., 2015 used music as an adjunct therapy to respiratory therapy for preterm infants. Music therapy duration for studies, except those reporting music therapy during surgery/ treatment, was between 15 minutes to 1 hour per session. Overall music intervention length of the studies varied significantly from a single session (example: during caesarean section) to over a month (example: 29-32 days for premature infants). Five of eighteen studies reported playing music from 25 dB to 70 dB. Another study mentioned using ambient speakers.

Characteristics of measuring device used

For measuring oxygen saturation

levels, seven of eighteen studies used a pulse oximeter (oxymeter) while four studies reported using different instruments - Primus Dräger (Lübeck, Germany), Vital monitoring system - DX 2010-LCD - Dixtal Biomedical, SAADAT monitoring system (SAADAT, Malaysia) and Mennen VL4000 bed-side monitor. The remaining seven studies did not mention the oxygen saturation level measuring device name.

The outcome of music therapy on oxygen saturation level

Eight out of eighteen papers (44.4%) concluded music therapy is an effective modality that showed statistically significant outcomes for improving oxygen saturation levels, while other ten (55.6%) studies did not show statistically significant outcomes. Nine out of eleven (81.8%) qualified papers concerning adults, children and adolescents focus on assessing the effectiveness of music on oxygen saturation either pre-, intra- and/ or post-operative/ treatment procedures. Amongst these nine studies, in adults, three out of four (75%) papers that concerned with open heart (Nilsson U, 2009), caesarean section (Handan E et al., 2018) and general surgery (Saritas et al., 2016) show increase of oxygen saturation levels of patients with music therapy intervention; while in children and adolescents, none of the papers reports improvement. Two papers concerning adult patients - one in ICU with head injury (Indriani, N. et al., 2018) and another (Antoniazza B et al., 2018) with terminally ill patients stated statistically significant outcome where oxygen saturation level raised with music therapy. Out of these nine studies concerning surgery/ treatment, ones that did not find music therapy effective include one study with adult patients undergoing open hernia operation (intra and post-) (Nilsson U et al., 2005); three studies (Dixit UB et al., 2020; Marwah N et al., 2005; Tshiswaka SK et al., 2020) with children undergoing dental treatment (intra-) and two (Calcaterra, Valeria, et al., 2014; Atiye Karakul et al., 2018) with children and adolescents undergoing day care surgery (post-). Two

(Jabraeili M et al., 2016; Elham Shafiei et al., 2020) out of six (33.3%) studies concerning preterm and premature infants had shown a positive effect of music therapy on oxygen saturation levels while four (66.7%) studies (Eskandari N et al., 2013; Cristiane Aparecida Moran et al., 2015; Diler Aydin et al., 2012; Aydın, D. et al., 2014) did not find music therapy effective for improvement of oxygen saturation level. In addition, the study (Berna Alay et al., 2019) with full-term newborns too showed statistically significant outcomes.

Discussion

Reviewed studies

The present literature review identifies eighteen papers that describe the therapeutic effect of different types and genres of music on the oxygen saturation level of 1,151 participants undergoing some diverse medical treatments. The literature review does not focus on participant equivalence, disease equivalence, or music equivalence. Accordingly, the review showed a mixed outcome. Due to the heterogeneity of the study types, participant profiles, music forms used and the mode of applying the intervention a comparison between the outcomes may not be justified; however, the conclusions from the review may help future researchers to explore and validate the conclusions.

Music therapy on oxygen saturation level

Music had diverse effects on patients' oxygen saturation levels as per the drawn conclusions. The review reports patients from different age groups, from neonates to adults of 80+ years of age, and thus the effectiveness of music on oxygen saturation level as per the outcome too varied significantly. Adult patients were found to benefit most from music therapy intervention, followed by premature/preterm or newborn infants, while included studies with children participants showed no effect of music on oxygen saturation levels. Papers narrating Western classical music's usage reveal better outcomes for the review.

wed literature. Administration of Western classical instrumental music in different forms helped increase oxygen saturation levels in adults in surgical intensive care units as well as in newborn patients under medical care. Mum's lullaby and Brahms' lullaby positively affected the oxygen saturation levels of preterm infants. Favourite songs were chosen by women undergoing multiple caesarean section delivery. Classical music for patients in the intensive care unit (ICU) and instrumental music from live musical performances for terminally ill patients significantly increased their oxygen saturation levels. Three papers with children having dental anxiety reported no change in the oxygen saturation level when administered with music therapy, including Indian classical music, Instrumental music, nursery rhymes, and Portuguese children's songs. All the studies in the literature review reported using receptive (or passive) music; while a single study reported that 1% of participants choose active live music therapy (instrumental music played by trained music therapists and nurses) as well. Pre-, intra-, and post-therapy observations reveal that in one paper improved oxygen saturation levels were sustained even after 15 minutes of music therapy, while in another, the improved levels were observed during the intervention and until the completion of therapy administration. Although many of the reviewed papers did not mention the types of instruments used to measure oxygen saturation levels, the ones mentioned did not significantly differ in outcomes.

Critical reviews, reflections, and gaps

The authors of the studies included in the literature review have offered a few important critical reviews, reflections, and gaps in the process, which may be significant for efficiently using music in clinical setups in the future. Those are bucketed under a few themes. 1) Continuity in using music in clinical setups: even though using music did not show the expected effect in a few studies, patients responded positively to the music and voted in favour of

listening to that in their subsequent visits (Marwah N et al., 2005).

Continuity in applying music therapy to patients may offer a better outcome. For example, in a couple of studies (Eskandari N et al., 2013; Cristiane Aparecida Moran et al., 2015) with premature infants, although there were no significant improvements in oxygen saturation levels, however, there was a decrease in respiratory rates after the end of music therapy intervention. 2) In-service music therapy training: in-service music therapy training for nurses in ICUs, their continued use, and extended application for patient-care services need to be encouraged (Saritas et al., 2016; Atiye Karakul et al., 2018). 3) Rhythm variation and silence: positive effect of music was seen through variation in rhythms and silence in between the music interventions in a study with Western classical music (Calcaterra, Valeria, et al., 2014). 4) Stabilisation of oxygen saturation levels: multiple studies (Diler Aydin et al., 2012; Aydın, D. et al., 2014; Indriani, N. et al., 2018; Atiye Karakul et al., 2018) showed music therapy helped stabilise oxygen saturation level irrespective of whether there was an improvement or not. 5) Music therapy expertise: four studies (Calcaterra, Valeria, et al., 2014; Saritas et al., 2016; Antoniazza B et al., 2018; Atiye Karakul et al., 2018) out of eighteen mention music design or selection by music therapist or trained/expert musicians; two mentions trained research assistant (Jabraeili M et al., 2016) or nurse (Nilsson U, 2009) while rest twelve papers did not mention using expert musicians or music therapists for designing/selection of music for intervention. 6) The mechanism in which music therapy works: studies that mention the improvement of oxygen saturation levels with music therapy do not clearly explain why it happens. A couple of studies (Nilsson U, 2009; Elham Shafiei et al., 2020) suggest positive outcomes with deep breathing caused by soothing music. A few studies (Eskandari N et al., 2013; Cristiane Aparecida Moran et al., 2015; Handan E et al., 2018 ;) do not report improvements in oxygen saturation

levels with music therapy; however, they report better respiratory rates and qualities than control groups. Other papers (Diler Aydin et al., 2012; Aydın, D. et al., 2014; Atiye Karakul et al., 2018) report retention of oxygen saturation within normal levels.

CONCLUSIONS

As is identified from the results and discussions of included studies in the review, it becomes evident that homogeneous research is required to comprehend how music therapy works on a similar patient base. Even with heterogeneity in included papers in the present literature review, either positive outcomes of music on oxygen saturation level improvement or no effect was reported; no negative outcomes were reported. The mixed result may be attributed to the diversity and heterogeneity.

Thus, an exact comparison of the results may not be justified because of the diverse nature of the studies. Secondly, how music therapy affects oxygen saturation levels is yet to be understood completely. For example, whether it depends on the type of patient groups; nature of the music such as classical music, lullaby or other music forms; live or recorded music; any soothing music that may positively affect respiratory activities resulting in deeper breaths; therapy duration; targeted music therapy procedural design; trained facilitators in clinical setups or apposite execution, needs to be researched extensively.

To realise the sustained experience of music therapy, a continuity in the therapy process with trained professionals is mandatory per the patient's status. This is the norm and is also being reported by the authors of the included papers.

The selection and designing of music therapy by the experts is an area that needs more focused details in research papers because experience in designing and applying music therapy might influence the efficacy of the therapy procedure as well as the overall experience of participants or patients. Further, the basis of choosing a piece of particular music for a specific pa-

tient condition is also not available, which again is very important to narrate; because designing relevant music intervention for therapy is important for a successful outcome that may not be homogeneous but may be targeted to the need and to be developed by experts in the domain. Researchers may utilise the findings (both positive outcomes, reflections, and critical reviews) of the present literature scan as base level understandings to design future research work on the effect of music therapy on oxygen saturation levels in patients undergoing treatment for different conditions. More and more clinical research studies with relevant music therapy design need to be conducted with different patient profiles to understand the efficacy of music therapy and for standardisation of outcomes in this domain.

Music therapy is a well-accepted, non-invasive, inexpensive, and easy-to-use modality that is used to address and improve patient conditions. Also, along with identified disease areas, surgical settings, day care treatments, preterm infants, and others, there is an emergent need to conduct research to assess music therapy's role on oxygen saturation levels of Covid-19 patients and survivors. There is a dearth of literature on this domain of scientific work. Overall, the review's findings and critical analysis emphasise how music therapy as a therapeutic modality can be helpful for promoting natural therapy and further benefit humankind holistically.

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Appendix

Table 1. Characteristics of included papers regarding effect of music therapy on oxygen saturation level

1 st author (year)	Age Range	# Sub-jects	Diagno-sis	Study Type	Music Form - Therapy Duration	Conclusions
Nilsson U (2005)	Mean age = 55 - 57 yrs.	75	Patients undergoing open hernia repair	RCT	Recorded classical music New-Age synthesizer; seven melodies that are soft and relaxing were :43 minutes to 1 hour :intra- and post- operatively :instrumental :pulse oximeter	There were no significant differences between the three groups (intra- music, pos- toperative music and silence/ control groups) with regards to SpO ₂ , however postoperative group reported less anxiety with music therapy.
Marwah N (2005)	4-8 yrs.	40	Anxious pediatric dental patients	Experimen- tal study	Recorded instrumental music and nursery rhymes music as per patients' choice :throughout treatment procedure :instrumental and vocal :pulse oximeter	The values of oxygen saturation showed minimal variations during all the visits with instrumental music and rhymes groups. The results were not statistically significant. Even though pain relief was less, the patients responded positively to the music therapy and wished for listening to the same during their subsequent visits.
Nilsson U (2009)	Mean age = 65.5 yrs.	40	Open Heart Surgery	RCT	Recorded soft and relaxing music MusiCure (Musi Cure) with different melodies of 60 to 80 beats per minute (bpm) :30 minutes; 50-60 dB :post-surgery :instrumental	The results found a trend towards higher SaO ₂ in the music group compared with the control group although there were no statistically significant result obtained. The author mentions that patients might have taken deeper breaths during music listening, which might have helped subside pain perceptions.
Diler Aydin (2012)	Preterm infants	26	Stress	Experimen- tal study	Recorded Turkish classical music :1 hour; 45-60 dB :during a scheduled time of the day : instrumental and vocal	No significant change in oxygen saturation levels was observed before and after music therapy intervention however the levels were maintained within normal limits between the trial and control groups.
D Aydın (2014)	Pre- mature Infants	60	Stress	Experimen- tal study	Turkish music CD of Dede Efendi :musical instruments used in the CD - reed flute, rebab, lute and dombra :30 minutes :during a scheduled time of the day :instrumental	Oxygen saturation values increased marginally at the onset attributed to the stimulating and relaxing effect of music therapy; however remained at the normal levels during hospital stay of 29-32 days. Overall, there was no statistically significant difference in oxygen saturation between the experimental and control groups.
Valeria Calcaterra (2014)	3 to 14 yrs.	42	Day surgical procedures (including orchidopexy, inguinal hernia repair, circumcision)	RCT	Six tracks of slow (70-80 beats/ min) and fast (140-150 beats/min) classical music (recorded) were used - <i>Andante Molto</i> A. Vivaldi; <i>Suite</i> J. S. Bach; <i>Suite</i> E. Grieg Holberg's Rigaudon; <i>Andante</i> W.A. Mozart; <i>Suite</i> J. S. Bach; <i>Allegro</i> A. Corelli :20 minutes :postoperative (while awakening) :instrumental :Primus Dräger (Lübeck, Germany)	While awakening at the recovery room SpO ₂ decreased significantly with respect to admission and end of surgical procedure times. There were no differences between the music and non-music groups.
Narges Eskandari (2014)	Pre- mature infants	120	Pre- mature infants	RCT	Recorded lullaby (goodnight kid, produced by the national radio of Iran) :20 minutes; 50-60 dB :during a scheduled time of the day :vocal :pulse oximeter	No statistically significant changes were seen in short term responses for oxygen saturation of premature infants following lullaby music intervention. However, infants listening to lullaby experienced decrease in respiratory rate at the end of the therapy session.
Cristiane Aparecida Moran (2015)	Pre- mature infants	26	pre- mature infants	RCT	Recorded classical music New - Age :21 minutes ; 25 dB :during respiratory (physical) therapy :instrumental :Vital monitoring system - DX 2010-LCD - Dixtal Boimedical	Between the control and experimental groups, there was no statistically significant difference in oxygen saturation level, however lower variation in respiratory rates were shown with music inclusion in experimental group.
S Çatlık Sarıtaş (2016)	18+ yrs.	202	Patients in surgical intensive care unit	Quasi-ex- perimental research	Recorded classical music Bach's, violin concertos :30 minutes; 60 dB :pre-surgery :instrumental	Oxygen saturation increased with music therapy and the difference was considered statistically significant (p<.001). Authors feedback were to offer in-service training of music therapy as nursing activity and maintain continuity.
Mahnaz Jabraeili (2016)	Preterm infants	66	Preterm Infants	RCT	Recorded folkloric (Turkish or Persian lullaby) in mother's voice (65-70 dB) and Brahms' lullaby (65 dB) :15 minutes each :during a scheduled time of the day :vocal :SAADAT monitoring system (SAADAT, Malaysia)	There were statistically significant difference in oxygen saturation of infants between Brahms' lullaby and mum's lullaby when compared with controls during 15 minutes after music. The conclusion was that music therapy may be administered for short-term vital benefits of the preterms.

1 st author (year)	Age Range	# Subjects	Diagnosis	Study Type	Music Form – Therapy Duration	Conclusions
Novi Indriani (2018)	Mean age = 36 yrs.	34	Head injury in ICU	Quasi-experimental study with pre-, post-design	Recorded Mozart’s music with a 60-80 beat size :90 minutes per day which was divided into 3 intervention times :morning, noon and afternoon :instrumental	Mozart’s music therapy had a significant effect on changes in oxygen saturation (p=0.008). The authors concluded that Mozart’s music therapy may help shorten the ICU stay of patients with head injury.
Handan Eren (2018)	Mean age = 31 yrs.	60	Caesarean Section delivery	Experimental study	Favourite songs chosen by patients (recorded) :throughout treatment procedure :vocal	A significant increase (p=0.017) in the oxygen saturation levels of women in the experimental group undergoing caesarean section procedure was observed. Authors mention better respiratory qualities in response to music therapy during caesarean procedures.
Barbara Antoniazza (2018)	Up to 80+ yrs.	50	Terminally Ill Patients	Pre and post-test study	Live instrumental music by music therapist and trained nurse :instruments used - guitar, long and/or wooden flute, maracas, drums, piano :30-40 minutes :during a scheduled time of the day :instrumental :pulse oximeter	The study witnessed positive effects and improvement of blood oxygen saturation with statistically significant result between pre- and post- tests (p<0.01) with live music therapy intervention. Authors conclude that their study offers a strong scientific evidence in favour of the efficacy of music therapy for terminally ill patients and should be used for all health settings.
Atiye Karakul (2018)	9-17 yrs.	65	Day surgery of children and adolescents	Pre- post-test control group study	Recorded The Art of The Fugue by Bach :20 minutes :post-operative recovery period/ awakening period :instrumental	The study did not find significant effect on the oxygen saturation value of children and adolescents who listened to music while awakening post-operation. However in the experimental group, music therapy helped retain the oxygen saturation level within normal limits.
Berna Alay (2019)	Full-term newborns	45	Physiological measurements and Stress symptoms	RCT	Mozart for Babies music CD11 (Valley Entertainment Inc, USA) and mother’s lullaby (both recorded) :30 minutes; 65 dB :during a scheduled time of the day :instrumental and vocal :Mennen VL4000 bed-side monitor	Oxygen saturation levels of full-term babies in the classical music group increased from the 10th minute and remained stable until the completion of intervention (p<0.05). Lullabies did not affect oxygen saturation level. The authors as a reason conclude that may be recorded lullaby was not as effective as the live vocal singing of the mother.
Uma B Dixit (2020)	4-6 yrs.	120	Dental anxiety in paediatric patients	RCT	Recorded Indian classical instrumental music (Raag Sohni, Pt. Shiv Kumar Sharma, santoor) :pre-, intra- and post- treatment procedure :instrumental :pulse oximeter	Music therapy had no appreciably clinically significant effects on oxygen saturation in this study. The authors report using music therapy for just 5 minutes during the dental treatment procedure and that may be too short a time to have an effect on the vitals.
Serge Kalongo (2020)	5 to 11 yrs.	40	Dental anxiety in children	Experimental study	Thirty-seven children’s songs in Portuguese were selected by the children. Four songs were played live with 6 stringed guitar (pre-). Same recorded songs were played during treatment from among the 37 songs :pre and intra- dental procedure :vocal :pulse oximeter	There was no significant difference in oxygen saturation in children who listened to music during dental care compared to the non-music group.
Elham Shafiei (2020)	Preterm infants	40	Preterm infants	Single group randomized clinical trial	Recorded mother’s Lullaby :20 minutes; 50 DB :during a scheduled time of the day :vocal :pulse oximeter	Statistical analyses showed a significant difference in oxygen saturation levels (p=0.039) of preterm infants between two stages of experiment – lullaby and non-lullaby. Authors conclude that the soothing effect might have caused decrease in sympathetic activities that eventually helped deep breathing and thus improved oxygen saturation level.