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Review Article

# Music therapy in patients with disorders of consciousness: an integrative review

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**Abstract:** Introduction: Music therapy is widely used for treatment and care in various diseases including disorders of consciousness, dementia, stroke, psychiatric disorders, Parkinson's disease, pain of several origins among others. It is known that listening to music influences mood and arousal, which can improve performance on a variety of cognitive tasks. Objective: To analyze the information available in the literature about scientific evidences of the use of music as a therapeutic resource. Method: This is an integrative review with search of articles published in national and international journals indexed in databases and journal banks: Pubmed, Cinahl, Web of Science and SciELO, between December/2017 and January/2018. We used the descriptors "music" and "disorders of consciousness" in Portuguese, English and Spanish. Results: We selected 14 heterogeneous studies with good methodological quality, among which we highlight interventional and observational studies with a degree of recommendation A. Conclusion: The study concludes to exist some evidence in the scientific literature about the effectiveness and efficacy of music therapy in the treatment and evaluation of people in coma, minimally conscious states and persistent vegetative state.

**Keywords:** *Music, Art Therapy, Consciousness Disorders.*

## Terapia musical em pacientes com distúrbios da consciência: uma revisão integrativa

**Resumo:** Introdução: A terapia com música é amplamente utilizada para tratamento e assistência em várias doenças, incluindo distúrbios da consciência, demência, acidente vascular cerebral, distúrbios psiquiátricos, Parkinson, dor de origens diversas, entre outros. Sabe-se que ouvir música influencia o humor e a excitação, o que pode melhorar o desempenho em uma variedade de tarefas cognitivas. Objetivo: Analisar as informações disponíveis na literatura sobre as evidências científicas do uso da música como recurso terapêutico. Método: Trata-se de uma revisão integrativa com buscas de artigos publicados em periódicos nacionais e internacionais indexados nas bases de dados e banco de revistas: Pubmed, Cinahl, Web of Science e SciELO, entre dezembro/2017 e janeiro/2018. Utilizou-se os descritores "música" e "distúrbios da consciência" de forma associada em português, inglês e espanhol. Resultados: Foram selecionados 14 estudos heterogêneos, porém com boa qualidade metodológica, dentre os quais se destacam estudos intervencionais e observacionais com grau de recomendação A. Conclusão: O estudo concluiu haver na literatura científica algumas evidências da efetividade e da eficácia da terapia musical no tratamento e avaliação de pessoas em coma, estados minimamente conscientes e estado vegetativo persistente.

**Palavras-chave:** *Música, Terapia pela Arte, Transtorno da Consciência.*

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# 1 Introduction

Therapy with music is widely used for treatment and assistance in various diseases, including disorders of consciousness, dementia, stroke, psychiatric disorders, Parkinson's disease, pain of various origins, among others (O'KELLY et al., 2014).

We know that listening to music influences mood and arousal, which can improve performance in a variety of cognitive tasks-called "Mozart effect" or "hypothesis of humor and arousal" (ROLLNIK; ALTENMÜLLER, 2014).

Music therapists and other health professionals has been using music in the field of health as another recourse in their professional practice (MORGAN, 2017). In the last 20 years, the number of researches about the use of music or music therapy in the hospital context has increased significantly, including a wide range of results in several of specialties (KAMIOKA et al., 2014).

As a non-pharmacological technique, music provides several benefits and is a low-cost therapy when compared with the costs of other therapies (GLASZIOU, 2015). The use of music, because it is a cheap technology and provides the improvement of the patient's experience, makes the question of using music in different contexts seem obvious, however the best way to use music in hospitals does not seem to be clear to the multiprofessional team, especially on their use in comatose patients.

Music therapy in people with disorders of consciousness (DC) has a long history, from the pioneering work of Professor Mary Boyle in 1983 (BOYLE; GREER, 1983) to current developments in diagnostic, evaluation and evidence-based interventions (O'KELLY et al., 2013). Despite the longevity of this investigation and the breadth of explored approaches, the literature on the use of music therapy in meeting the clinical needs of this population, as a way to improve empirical evidence, remains scarce.

Dr. Aldridge, in the 90 decade, suggested that improvised music therapy could be a useful adjuvant therapy in such situations, both for the patient and for the team. He quoted a case where a music therapist started working with comatose patients. They treated five patients, between 15 and 40 years old, with severe coma (a Glasgow Coma Scale score between 4 and 7). Each music therapy contact lasted between 8 and 12 minutes. The therapist improvised his learning without words based on the rhythm of the patient's pulse and, more relevant, in the patient's breathing pattern (ALDRIDGE; GUSTORFF; HANNICH, 1990). There were a number of reactions such as breathing change (it became slower and deeper), fine motor movements, claw hand movements and turning the head, the eyes opening to regain consciousness. When the therapist started singing, the heart rate slowed down. Then the heart rate increased rapidly and sustained a high level until the end of the contact. This effect, which indicates arousing and perceptive activity, disappeared after music therapy stopped (ALDRIDGE; GUSTORFF; HANNICH, 1990).

The demonstration of the efficacy of music required a scale or sufficiently sensitive measures to show behavioral changes in a population as complex as patients with disorders of consciousness (DC). This was the challenge that led to the development and standardization of the Music Therapy Assessment tool for awareness of disorders of consciousness or MATADOC (MAGEE et al., 2014). This measure can demonstrate behavioral signs of responsiveness to auditory stimuli in the person with disorders of consciousness; nowadays MATADOC is the most relevant assessment tool due to the diagnostic value, relevant to the interdisciplinary care of these patients.

In view of the comprehension of the therapeutic potential of music, it is hypothesized the possible efficacy and efficiency of its use in patients with DC. Due to the lack of knowledge of professionals about how to perform this practice, as well as the little elucidation about its use in different contexts, especially in hospital institutions, this review study intends to analyze the scientific evidences available in the literature on the use of music as a therapeutic resource in patients with DC.

# 2 Method

This is an integrative review, whose purpose is to gather and synthesize research results on a specific topic or subject, in a systematic and orderly manner, thus contributing to the complete comprehension of the theme studied. In order to operationalize this integrative review, we used the following methodological steps: Definition of inclusion and exclusion criteria; Definition of the information to extract from the selected studies; Categorization of studies; Analysis and interpretation of data; Evaluation of the results included in the integrative review and presentation of the review/synthesis of knowledge (SILVA; MENEZES, 2005).

We searched, between December/2017 and January/2018, for articles published in national and international journals indexed in the following

databases and magazines: Pubmed, Cinahl, Web of Science and SciELO. We obtained the texts in full by electronic means in the CAPES portal of journals with access obtained through the *Universidade Federal do Maranhão (UFMA)*. We used the descriptors in Health Sciences (HSDe): "music" and "disorders of consciousness", in Spanish *"música" y "trastornos de la consciencia"* and their correspondents in English by the Medical Subject Headings (MesH) "music" and "consciousness disorders", in an associated way.

We selected the articles according to the following inclusion criteria: presence of the descriptors chosen in the title of the paper or in the abstract; articles available in full; productions in English, Spanish and Portuguese, published between January 2013 and January 2018; sample of the studies comprised of adults and elderly people. As exclusion criterion, we filtered studies associating the use of music with another technique or therapy. We did not include secondary studies (systematic reviews, meta-analyses or literature reviews), as well as studies conducted with pediatric and neonatal population.

After the application of the above criteria, we found 171 articles (107 in PubMed, 53 in Web of Science, 02 in Scielo, 09 in Cinahl). From PubMed we selected 07 articles, in Web of Science 01 article, in Scielo 02 articles and in Cinahl 04 articles, 14 articles that we included in the sample. We discarded 157 articles and 56 articles appeared repeatedly in more than one database, 45 did not have access to the full text, 35 referred to neonates and children and 21 were secondary studies.

To catalog the articles and later evaluation, we elaborated a data collection instrument. The instrument consisted of: name of the journal, year of publication, area of knowledge, origin of the article, title of the article, objectives, type of study, characteristics of the sample, instruments and variables studied, level of evidence and degree of recommendation. We performed the analyses through reading and grouping the articles based on the elaborated instrument. We showed the findings in the form of tables and in descriptive language. The base of level of evidence and degree of recommendation was the Oxford Centre for Evidence-based Medicine (CENTRE..., 2009) scale due to its diversity of evidence classification by types of studies.

# 3 Results

The results show that studies about music therapy in disorders of consciousness are heterogeneous, that there are few worldwide researchers in the area, and some stand out such as Wendy L. Magee, a researcher at Temple University in Philadelphia-USA, with many studies in the area, some included in Table 1 - characterization of the selected studies.

In Table 2 - findings of the studies, we classified them as to their highest level of evidence and their highest degree of recommendation according to the Oxford Centre for Evidence-based Medicine scale. The findings in Table 2 follow the same order of the studies in Table 1.

All selected studies focused on the properties of arousal, attention and mood activation by music therapy. The method used in all studies was stimulation by auditory pathway and without the presence of other noise in the environment.

# 4 Discussion

## 4.1 Performance of music in the Central Nervous System

When an individual is exposed to music, the sound stimulates the cochlea, medulla oblongata to the auditory cortex, promoting arousal and attention in the patient activating the thalamus, anterior cingulate gyrus and the dorsolateral prefrontal cortex. According to the type of music and melody (chords), there will be emotional stimulation (limbic and paralytic system: internal surfaces of the frontal lobes, cingulate gyrus, amygdala, hippocampus and Mesencephalon), in normal individuals there will be cognitive improvement, motor performance and humor (ROLLNIK; ALTENMÜLLER, 2014).

In patients with conscious disorders, the responses will be as below.

Heine et al. (2015), when studying the auditory response during musical stimulation, observed that the auditory network showed significant functional connectivity with the left pre-central gyrus and the dorsolateral left prefrontal cortex in the group of patients exposed to music compared to the control group of patients. The external network in patients was restricted to the sulcus and lower lobes, dorsolateral, middle frontal and supramarginal during the control and music conditions.

Riganello et al. (2015), in his controlled clinical trial, verified the influence of music on the autonomic nervous system and concluded that the type of music and musical parameters alters and stimulates different emotional responses in patients with DC. Listening to music is a complex experience and the ability to respond to musical stimuli depends on a strong individual variability. The close relationship

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**Table 1.** Characterization of the selected studies.

| Order | Journal | Knowledge area | Study origin | Title | Objective | Sample |
|---|---|---|---|---|---|---|
| 1 | Archives of Physical Medicine and Rehabilitation | Medicine | England | Music Therapy Assessment Tool for Awareness in disorders of consciousness disorders: assessment of awareness in disorder of consciousness | To investigate the psychometric properties of the music therapy assessment tool for awareness in disorders of consciousness (MATADOC). | 21 adults |
| 2 | Brazilian Nursing Magazine | Nursing | Brazil | Patients with disorder of consciousness: vital responses, facial and muscular with music or message [10] | To compare Vital signs, facial expression and basal electroneurographic signs with measurements during music, message or "silence" stimuli in coma, vegetative or sedated state patients. | 76 patients in 3 groups: Music: 30 Messages: 26 Silence: 20 |
| 3 | European Review for Medical and Pharmacological Sciences | Medicine | China | Music therapy for coma Patients: preliminary results | To apply quantitative EEG (valor $\delta + \theta / \alpha + \beta$) and value GCS to assess the role of music therapy in patients in traumatic coma due to brain injury. | 40 Experimental group = 20 Control group = 20 |
| 4 | Frontiers in Psychology | Psychology | Belgium | Exploration of functional connectivity during stimulation of favorite music in patients with disorders of consciousness | To investigate how music modifies the functional connectivity of the brain in the disturbance of consciousness. | 5 Patients exposed to a classic functional connectivity scan and a scan while they were exposed to their favorite songs. |
| 5 | Frontiers in Neuroscience | Neuroscience | Italy | How can music influence the autonomic nervous system response in patients with severe consciousness disorder? | To analyze the autonomic response to musical stimuli by means of normalized parameters of low frequency (nuLF) and Entropy sample (SampEn) of parameters of Heart Rate Variation (HRV) and its possible correlation with the complex difference of four music samples (for example, Mussorgsky, Tchaikovsky, Grieg and Boccherini) in healthy individuals and patients with disorders of consciousness. | 18 patients Experimental group = 9 individuals with DC Control group = 9 healthy individuals. |

Source: Authors.

**Table 1.** Continued...

| Order | Journal | Knowledge area | Study origin | Title | Objective | Sample |
|---|---|---|---|---|---|---|
| 6 | Neuropsychological Rehabilitation | Neuropsychology | United States | Music Therapy Assessment Tool for awareness of disorders ofconsciousness (MATADOC): standardization of the main subscale to assess consciousness in patients with disorders of consciousness | To examine the psychometric properties of the main subscale of a tool for music therapy evaluation (MATADOC) developed for use in adult patients with disorders of consciousness. | 21 patients |
| 7 | Frontiers in Human Neuroscience | Neuroscience | England | Neurophysiological and behavioral responses to music therapy in vegetative and minimally conscious states | To compare Electroencephalogram (EEG), heart rate variability, breathing and behavioral responses of 20 healthy individuals with 21 individuals in vegetative or minimally conscious states exposed to music therapy. | Experimental group = 21 Control group = 20 |
| 8 | Journal of Neurology | Neurology | Italy | Active approach of music therapy in Consciousness disorders: a series of controlled observational cases | To evaluate the effects of active music therapy (AMT) on some physiological parameters and behavioral responses in disorders of consciousness. | 10 patients (5 With cerebral anoxia, 4 with cerebral hemorrhage and 1 with TBI) divided into 2 groups. G1 with 4 patients with Glasgow Coma Scale 4 and G2 with 6 patients with ECG 2. |
| 9 | Journal of Music Therapy | Music therapy | England | Music Therapy Assessment Tool for awareness in disorders of consciousness (MATADOC): reliability and validity of a measure to assess awareness in patients with disorders of consciousness | To determine the measurement characteristics and properties of subscales 2 and 3 of the questionnaire MATADOC. | 21 patients with disorders of consciousness |
| 10 | Neurorehabilitation and Neural Repair | Neurorehabilitation | France | Boosting cognition with music in patients with disorders of consciousness | To evaluate the effect of music on brain processing in patients with disorders of consciousness. | 13 patients with disorders of consciousness |

Source: Authors.

**Table 1.** Continued...

| Order | Journal | Knowledge area | Study origin | Title | Objective | Sample |
|---|---|---|---|---|---|---|
| 11 | Revue Neurologique | Neurology | France | Beneficial effect of preferred music on cognitive functions in patients with a state of minimum consciousness | To compare the effect of the patient's favorite music with another continuous sound (control) on the relational behavior of patients in minimal state of consciousness (MSC). | 6 patients |
| 12 | Frontiers in Neuroscience | Neuroscience | Austria | Neuroscientific and neuroanthropological perspectives in the research and practice of music therapy with patients with disorders of consciousness [5] | To discuss the relevance of the neuroanthropological perspective about our way of obtaining knowledge and its influence on therapeutic practice. | Not applicable |
| 13 | Interdisciplinary | Interdisciplinary | Argentina | Music therapeutic interventions for the activation of the reticular system | To describe the different altered states of consciousness and the interventions that use sound and its elements in the diagnostic and therapeutic approach of patients in a state of minimal consciousness and their effect on reticular formation. | Not applicable |
| 14 | Frontiers in Psychology | Psychology | United States | Sensory stimulation programs and music therapy to treat disorders of consciousness | To talk about sensory stimulation programs and music therapy to treat disorders of consciousness | Not applicable |

Source: Authors.

**Table 2.** Study findings.

| Order | Author/year | Type of study | Results/ Conclusion | Level of evidence | Degree of reccommendation |
|---|---|---|---|---|---|
| 1 | Magee et al. (2017) | Interventional-double blind controlled clinical trial | The authors concluded that auditory responsiveness is the main factor in the responses to stimuli provoked by music in patients with DC | 1B | A |
| 2 | Puggina and Silva (2015) | Cross-sectional | Statistically significant alterations in the variables temperature, facial expression, electroneuromyography and Glasgow Scale; more frequent alterations in session 2, in patients with coma and vegetative state, in the frontal muscle and in the experimental group. | 1B | A |
| 3 | Sun and Chen (2015) | Interventional-controlled clinical trial | The value of the Glasgow Coma Scale increased in the music group after treatment when compared to the control group. The difference between the two groups was significant ($p < 0.05$). The value of the quantitative electroencephalogram (EEG) (value $\delta + \theta/\alpha + \beta$) of the music group decreased after treatment and the difference was significant in comparison with the control group ($p < 0.05$). They found that music therapy has an effect on the promotion of recovering consciousness. The quantitative EEG ($\delta + \theta/\alpha + \beta$ value) can be used as an objective index to evaluate the state of cerebral function. | 1B | A |
| 4 | Heine et al. (2015) | Interventional-quasi experimental | The auditory network showed greater functional connectivity with the left precentral gyrus and the left dorsolateral pre-frontal cortex during music, compared to the control condition. In addition, the functional connectivity of the external network improved during the music condition at the temporal-parietal junction. Although it is necessary to be careful due to the small size of the sample, these results suggest that exposure to favorite music may have effects on the auditory network of patients (implicated in the perception of rhythmic music) and in the brain regions linked to autobiographical memory. | 1B | A |
| 5 | Riganello et al. (2015) | Interventional-controlled clinical trial | The results showed that the internal structure of music (rhythm, melody, tones, semitones, voice) can change the autonomic response in patients with disorders of consciousness. | 1B | A |

Source: Authors.

**Table 2.** Continued...

| Order | Author/year | Type of study | Results/ Conclusion | Level of evidence | Degree of reccommendation |
|---|---|---|---|---|---|
| 6 | Magee et al. (2014) | Cross-sectional | The protocol that mainly uses musical stimuli (MATADOC) for evaluation and treatment of patients with DC showed sensitivity to measure auditory responsiveness and intra reliability. | 1B | A |
| 7 | O'Kelly et al. (2013) | Interventional-quasi experimental | Music therapy provoke a series of responses indicative of arousal and selective attention. Combined music therapy and neurophysiological evaluation could provide a distinct contribution, revealing an intact response to protruding stimuli (eye and mouth movements, eye blink), even in patients in vegetative state. | 1B | A |
| 8 | Raglio et al. (2014) | Observational | The systematic observations showed improvements, especially in the minimally conscious state group (G1), in some behaviors observed: eye contacts, smiles, communicative use of instruments/voice, and reduction of irritation and expressions of suffering. In the vegetative state group (G2), only ocular contacts strongly increased during treatment. | 1C | A |
| 9 | Magee et al. (2016) | Longitudinal | The selection of stimuli with emotional, autobiographical or self-correlated characteristics is fundamental in the use of music in people with DC | 2B | B |
| 10 | Castro et al. (2015) | Cross-sectional | The cerebral response to the patient's first name was more frequent in the music condition than in the control condition. In addition, the presence or absence of a discriminative response in the music condition seems to be associated with a favorable or unfavorable outcome, respectively. | 2C | B |
| 11 | Verger et al. (2014) | Observational | This new protocol suggests that favorite music has a beneficial effect on the patients' cognitive abilities. The results also suggest that brain plasticity can improve in autobiographical contexts (emotional and family). The suggestion is to enlarge the findings with a larger number of patients to validate the hypothesis of the beneficial effect of music on cognitive recovery. | 2C | B |

Source: Authors.

**Table 2.** Continued...

| Order | Author/year | Type of study | Results/ Conclusion | Level of evidence | Degree of reccommendation |
|---|---|---|---|---|---|
| 12 | Vogl et al. (2015) | Qualitative | Brain images such as PET cannot sufficiently determine the impact on patients'' lives. An additional behavioral observation, such as video analysis, can provide information about a patient's condition. However, it is static and inflexible, as it captures only a short period. Neuroanthropology can help to close this gap, reflecting on the information collected in the patient's environment, which is necessary for a careful interpretation of the data. | 4 | C |
| 13 | Abrahan, Fischer and Justel (2017) | Descrpitive | It was possible to highlight the relevance of patients' relatives and friends' collaboration in the therapeutic process, providing information and possible resources at all levels of awareness, for a therapeutic process adequate evaluation and planning and when the professional selects the music, to do it according to the condition, age, gender and musical background of the patient. | 5 | D |
| 14 | Schnakers, Magee and Harris (2016) | Descriptive | The results indicated that interventions with music both baseline and post-treatment provoked higher-level responses involving behaviors that demonstrate greater complexity, particularly in the auditory and language domains. These results are relevant to contribute to the differential diagnosis in patients with DC. | 5 | D |

Source: Authors.

between the central autonomous network structures and listening of music can play a relevant role in the use of music in patients with DC. Music therapy in coma patients due to traumatic brain injury (TBI) has an effect on the promotion of consciousness recovery. Quantitative electroencephalogram (EEG) can be an objective index to evaluate the state of cerebral function (SUN; CHEN, 2015).

Schnakers, Magee and Harris (2016) adds that music interventions can be modified according to the patient's response "at the moment". Protruding auditory stimuli, such as family voices, increase the probability of observing cerebral and behavioral responses in patients with DC. However, listening to music may offer a superior auditory stimulus, believed to involve key areas of consciousness support (primary and secondary auditory cortices).

Abrahan, Fischer and Justel (2017) confirms that it is possible to distinguish physiological changes in patients with music therapy interventions. These changes represent cerebral activation, increased attention and alert levels, which when receiving sensitive and sensory information acts as a filter, selecting some stimuli and discarding others. Thus generating a level of alert that predisposes to better capture the stimuli and generate appropriate responses to the environment.

### 4.2 Behavioral influence of music

The study of O'Kelly et al. (2013), which involved the behavioral assessments, provided greater accuracy in the diagnosis compared with the neuroimaging methods. This study indicated a series of significant responses in healthy individuals that correspond to arousal and attention in response to their favorite music, including simultaneous increase in breathing rate with globally improved EEG power. In addition, the behavioral data showed a significantly higher burst rate in the EEG for the favorite music within the vegetative state group.

Raglio et al. (2014) evidenced improvements in some behaviors observed, especially in the group in a state of minimal consciousness, such as eye contact, smiles, communicative use of instruments/voice, and reduction of irritation and expressions of suffering. In the vegetative state group, only eye contacts increased strongly during treatment. The observations showed a tendency of behavioral responses to sound-musical stimulation (improvement of communication and emotional expressions).

Vogl et al. (2015) believes that when it comes to conducting researches within a therapeutic environment with human interaction, as we do music therapy, many relevant aspects occur at a subjective level that are difficult to illustrate in objective terms.

This author recognizes that neuroscience supports the understanding of the effect of musical therapy on the level of brain activity of people with DC. However, brain images such as PET cannot sufficiently determine the impact on patients' lives. As a patient with DC cannot express themselves with the familiar means of communication, both neuroscience and behavioral observations represent a risk of misinterpretation.

Neuroanthropology can help to bridge this gap, reflecting on the information collected in the patient's environment, which is necessary for a careful interpretation of the data. The author encourages the use of experiences, sensation, meaning and perception as relevant sources of knowledge, bringing together the different internal and external worlds of each individual involved and perceiving the relevance, not only of objective data, but also of the experience.

Puggina and Silva (2015) compared three groups (one control, one experimental message and one experimental music), and when considering all patients with DC, regardless of the etiology of unconsciousness, the music seemed to be a more intense stimulus. Both the music and the message provoked muscular tension in patients with disorder of consciousness rather than relaxation. However, specifically in the sedated patients, the music provided relaxation while the message produced tension.

Magee et al. (2016), in his study of 36 months, applied the evaluative methodology MATADOC (methodology developed in 17 years) with the objective to provide a rigorous and detailed evaluation of the auditory responsiveness in patients with DC. The music used varies between an unknown song and a familiar music with personal meaning to the patient. Besides the auditory modality, MATADOC also examines other behavioral domains. Magee concluded that MATADOC offers clinicians a useful measure to document behaviors consistently. According to Magee et al. (2017), MATADOC has greater sensitivity to evaluate the auditory responsiveness than other standardized assessments, suggesting that it is useful for the interdisciplinary assessment of consciousness in the DC to complete existing DC measurements.

## 5 Conclusion

O estudo conclui haver na literatura científica algumas evidências da eficiência e da eficácia da terapia musical no tratamento e avaliação de pessoas

em coma, estados minimamente conscientes e estado vegetativo persistente, porém, são necessários mais estudos sobre níveis de intensidade aplicáveis da terapia musical e especificações do seu uso nos mais diversos contextos, a fim de subsidiar revisões sistemáticas para construção de protocolos e instrumentação para uso nos hospitais.

The very high heterogeneity of the studies selected in this review seems to complicate the immediate use of musical therapy in certain pathological conditions, however, as the disorders of consciousness, highlights research opportunities.

The study concludes there are in the scientific literature some evidences of the efficiency and efficacy of music therapy in the treatment and evaluation of people in coma, minimally conscious states and persistent vegetative state. However, more studies on applicable intensity levels of musical therapy and the specifications of its use in various contexts are important to subsidize systematic reviews for the construction of protocols and instrumentation for use in hospitals.

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## Author's Contributions

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